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Dyeing

Aniline Black and Sulfur Black on Cotton and Rayon Goods

Some Notes on Practical Dyeing Methods

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IN SPITE of the pleasing attractiveness of brightly colored garments and fabrics it cannot be denied that black is a shade which is always popular. Not only can an all-black garment be made subtly attractive, but black material can always be incorporated in a colored garment for the purpose of the better showing up the brighter colors. Thus it would appear that the dyer will always be called upon to dye black.

Black shades on cotton and rayon materials can be produced by a variety of methods, and it is necessary to select that method which will give the required degree of fastness. As a matter of fact, the range of fastness which can be obtained extends over very wide limits—from a common direct black to the well-known fast Aniline Black.

At the present time, direct black shades (obtained with and without after-treatment and Naphtol AS blacks are not so much used on piece goods as on knitted and hosiery materials. Since this article is more concerned with piece goods and the faster black dyes applied to these, attention will more particularly be given to sulfur and aniline black dyeing. Reference will therefore be made to the following:—

1. *Sulfur black* dyes as applied to cotton, cotton viscose rayon, cotton acetate rayon.

2. *Aniline black* as produced on cotton, cotton viscose rayon, cotton acetate rayon, and acetate rayon.

In the first place it may be mentioned that although the term black appears to denote *one* definite color this is not the case. It must recognize that there is a very large number of tones of black. If one places on a table half a dozen pieces of black-dyed fabric then it is likely that no two of the patterns will have exactly the same shade or tone of black; one will be redder, another greener, another bluer, etc. Contrary to the general belief, it is usually as difficult to match a black shade as it is an orange, red, or other color. In general it is found, however, that reddish black shades are not wanted; blue or bluish green black shades are much more pleasing.

1. SULFUR BLACK DYEING

Turning now to particular methods of dyeing black attention will first be given to *Sulfur Black* shades.

Dyeing of sulfur black is very widely carried out since the resulting dyeings are quite fast to washing although they can be produced very cheaply. For a cheap fast-to-washing black on cotton or viscose rayon it is nearly always advisable to employ sulfur dyes.

(a) Dyeing of Cotton

In this article it is not desirable to give full details of the application of sulfur dyes to cotton materials since this style of dyeing is now well known. But it will be useful to draw attention to certain special features.

A general dyeing procedure consists of dissolving the dye by boiling it with its own weight of sodium sulfide conc. (or *twice* its weight of sodium sulfide crystals) to which has been added a small amount of sodium carbonate for the purpose of neutralizing any acidity in the water employed; the presence of an acid would have the effect of decomposing the sodium sulfide and liberating sulfuretted hydrogen gas. Under these conditions the sulfur black dye is reduced to a water-soluble form which has a direct affinity for cotton and similar fibers. Thus the material to be dyed can then be worked in the reduced dye liquor, and afterwards exposed to air when the dye present in the fibers is almost immediately oxidized back to its original water-insoluble form. Dyeing is most satisfactorily carried out near to boiling point, and the addition of common salt or Glauber's salt towards the end of the dyeing process much assists the production of deeper shades.

It is possible, by selected methods, to produce aqueous solutions of sulfur black dyes in their fully oxidized form,

but these, curiously enough, have no dyeing properties. Thus Thional Black G can be dissolved in a solution of sodium sulfite, but if cotton be boiled in this solution no dyeing takes place. But as soon as a small amount of a reducing agent such as sodium sulfide be added to this liquor the cotton becomes dyed black. Under careful control it is also possible to produce an aqueous solution of Thional Black G (fully oxidized) by dissolving this dye in sodium sulfide liquor in the usual manner and then blowing through it air sufficient to fully oxidize the dye without precipitating it; such a dye liquor does not dye cotton. Obviously cotton has an affinity only for the reduced dye.

The black shade to be obtained on cotton goods is largely determined by their preliminary preparation for dyeing. The general practice is to give the cotton yarn or fabric a thorough scour with dilute alkali, for example soda ash, and then dye. In order to obtain economy as regards labor and time the cotton material is scarcely ever bleached before dyeing, although experience shows that an improved black shade (deeper) can thereby be obtained. The black shade which results is better in proportion to the degree to which the natural fats and waxes are removed from the cotton before dyeing since these appear to hinder penetration by the dyestuff particles.

When a very good shade of black is required on cotton fabric it is advisable to mercerize the fabric first. Following mercerization, the fabric may be soured, washed, and dried, or the mercerizing alkali may be lightly rinsed out and the fabric immediately dyed. It is found that these two procedures have a considerable effect on the shade of black produced. As might be expected, the fabric which is not entirely freed from the mercerizing alkali before dyeing gains the deeper shade. But it is also noticed that the tone of shade is often quite different from that produced when the fabric is freed from alkali by souring before dyeing. The difference of tone will depend on the particular dyestuff employed, but in the writer's experience a blue-black shade has invariably been obtained on the non-soured fabric. Obviously this phase of sulfur black dyeing is well worth further investigation.

When a cotton fabric is not sufficiently scoured before dyeing there is considerable risk of obtaining reddish or bronzy shades of black. By means of a few simple experiments it is not difficult to show that when sulfur black dye is deposited on the surface of a cotton material it has a definitely reddish tone. Hence the better the absorbent properties of the cotton the less likely is a bronzy shade to result, and apparently no one finds such a tone of black pleasing. A bronzy shade must always be avoided. But bronziness is not always due to the waterproof properties of the fabric being dyed; it sometimes results from a diminished solubility of the sulfur dye in the dye liquor. If too much common salt be present or there is an insufficient amount of reducing agent then the dye seems more liable to be deposited on the surface of the cotton material.

One method for guarding against the production of bronzy shades of black consists of adding to the dye liquor a small amount of glucose, but as will be pointed out later it is then desirable to dye at a comparatively low temperature, say not exceeding 75° C.

Another method for neutralizing the redness of a sulfur black dyeing is that of adding to the dye liquor a suitable amount of a yellow direct dye which is not decomposed by the reducing agent present. A number of such direct dyes are available (they are mostly Stilbene dyes) and Chlorazol Fast Yellow BN, may be mentioned as being particularly useful. It is less satisfactory to add a sulfur yellow dye since many of these lack the fastness-to-light which is possessed by the type of direct yellow dye just mentioned.

(b) Dyeing of Cotton and Viscose Rayon

In dyeing sulfur black shades on *cotton-viscose rayon* materials it is necessary to bear in mind the important fact that the rayon absorbs more of the dye than does the cotton. Hence there is always a tendency for such mixture materials to have a reddish tone—due entirely to the excessively dyed viscose rayon. When cotton or viscose rayon are very heavily dyed with sulfur black dye they acquire bronziness. The obvious remedy consists of restraining the absorption of dye by the rayon, but this is not always easily accomplished. The writer has found the use of glucose in the dye liquor to give the best results, but again the temperature of dyeing must be lowered as previously indicated. Alternatively, but not quite so satisfactory, the mixture fabric should be dyed so that the cotton is left slightly pale while the viscose rayon is only slightly over-dyed; in a plain fabric the overall appearance is then quite good but obviously the method cannot be applied to materials in which the rayon forms definite pattern areas.

The difference between cotton and viscose rayon as regards their affinities for sulfur dyes are somewhat less noticeable when the dye liquor is prepared with sodium hydrosulfite instead of sodium sulfide. So far, it has not been mentioned that this powerful reducing agent is useful in sulfur black dyeing, but such is the case. It is however necessary to point out that since sodium hydrosulfite is much dearer than sodium sulfide it is only practical to use it for special materials which can carry the increased dyeing charges. Moreover, the reducing action of sodium hydrosulfite towards sulfur dyes is distinctly different from that of sodium sulfide, and in some instances it has been found that sodium hydrosulfite is definitely unsatisfactory.

When a sulfur black dye is dissolved in a sodium sulfide solution the resulting liquor is greenish black, but when sodium hydrosulfite is used instead of the sodium sulfide the liquor is slightly greenish yellow in color. A sulfur black dye liquor prepared with sodium hydrosulfite is thus somewhat similar in color to that of an indigoid vat dye liquor. But the important point worth noting is that under the usual large scale conditions of dyeing somewhat less tinctorial value is obtained from a sulfur black dye liquor when prepared with the hydrosulfite instead of the sulfide. No reason can be given for this fact unless

it be that the sodium hydrosulfite is so much more powerful a reducing agent than sodium sulfide that it slowly decomposes the sulfur black dye. Hence sodium hydrosulfite is not satisfactory when standing baths are employed.

(c) Dyeing Cotton and Acetate Rayon

In dyeing *cotton-acetate rayon* fabrics with sulfur black dyes it is generally desired to leave the rayon white in contrast to the black cotton. Acetate rayon has scarcely any affinity for sulfur black dyes so that from this viewpoint there should be no difficulty of securing white acetate rayon effects. But since the sulfur dye liquor is distinctly alkaline there is the probability that this will gradually hydrolyze the rayon during dyeing so that it acquires the dyeing properties of viscose rayon and then become stained with the sulfur black dye. It is possible to avoid this difficulty by one or other of several methods which will here be mentioned.

A sulfur dye liquor prepared with sodium hydrosulfite has scarcely any hydrolyzing action on acetate rayon so that excellent black and white effects can be obtained on cotton-acetate rayon materials by dyeing in a sulfur black dye liquor prepared in this manner. It is preferable to effect dyeing at a temperature which does not exceed 75° C. and to have present either quite a small proportion of soda ash or a larger quantity of ammonia; the addition of this alkali is for the purpose of neutralizing any acidity which arises from the sodium hydrosulfite (frequently this substance is acid as a result of slow decomposition during storage). During dyeing it is advisable to add small amounts of sodium hydrosulfite from time to time since the dye liquor readily oxidizes by exposure to the air.

In a second method of dyeing so that the acetate rayon is left white use may be made of a process discovered several years ago by Lodge and Evans and which was originally applied to the dyeing of wool with sulfur black dyes so that this animal fiber was not adversely affected. The method depends on the fact that when ammonium sulfate is added to a solution of sodium sulfide the following reaction may be assumed to take place:

$$Na_2S + (NH_4)_2SO_4 = Na_2SO_4 + (NH_4)_2S$$

Sodium sulfide Ammonium sulfide

so that most of the sodium sulfide is converted into ammonium sulfide which apparently is less alkaline and reactive towards acetate rayon. At any rate it is found that acetate rayon is not appreciably hydrolyzed in a sodium sulfide solution to which has been added the appropriate amount of ammonium sulfate. Also the dye liquir has strong dyeing properties so that very deep shades may be obtained on the cotton component of the mixture material. On the other hand it is important to avoid the use of excess of ammonium sulfate since under these conditions the sulfur black dye seems to lack solubility and pale slate-colored shades result.

A third method is that in which the hydrolyzing action of the sodium sulfide is neutralized by the presence in the dye liquor of a suitable amount of glucose. This method has been found by the writer to give the most satisfactory dyeings but only when carefully controlled. The feature which recommends this process is that the resulting dyeings have a pleasing black appearance which are also free from bronziness.

In dyeing by this method the most important point is to prepare the dye liquor correctly. Firstly, the sulfur black dye should be dissolved to form a concentrated liquor with the usual amount of sodium sulfide conc. (about equal amounts of dye and sodium sulfide). This liquor should then be heated to about 70° C. and into it then stirred twice as much glucose as sodium sulfide. On stirring, reaction occurs between the sodium sulfide and the glucose so that heat is generated and the temperature of the liquor increases to about 85° to 90° C. The temperature then commences to fall, and the liquor is then ready for adding to the jigger or other dyeing machine containing a suitable amount of water for dilution purposes. Dyeing of the cotton-acetate rayon fabric should then be carried out at about 30° to 40° C. when it will be found that while the cotton is dyed to a good black shade the acetate rayon remains quite white.

Quite a large amount of cotton fabric which is required to have a black schreinered finish contains worsted selvedges which are required to be left white and thus give the fabric an attractive appearance. If such cotton-wool fabric is dyed sulfur black under the usual conditions the wool is stained badly, and moreover, it is attacked by the alkali of the dye liquor so that it becomes brittle and harsh. It is therefore necessary to employ a dyeing procedure somewhat similar to either of those described above for cotton-acetate rayon fabrics.

For cotton-wool materials it is advisable to use the sodium sulfide dye liquor to which has been added the correct amount of ammonium sulfate as devised by Lodge and Evans. From practical experience it is found that the wool is completely unattacked and unstained provided that the temperature of dyeing does not exceed 35° C. Of course, some sulfur black dyes are liable to stain wool or acetate rayons more than others, so that before dyeing it is desirable to make preliminary tests in order to select the most satisfactory dyes.

It may here be mentioned that ammonium sulfide is an excellent reducing agent for dissolving sulfur dyes although it is less convenient and more costly than sodium sulfide. As in the Lodge-Evans process it has been noted that the addition of ammonium sulfate to a sodium sulfide solution is presumed to have the effect of converting the sodium sulfide into ammonium sulfide thus:

$$Na_2S + (NH_4)_2SO_4 = Na_2SO_4 + (NH_4)_2S$$

From this reasoning it might be assumed that similar sulfur black dye liquors prepared with the aid of ammonium sulfide itself or a mixture of sodium sulfide and ammonium sulfate would give similar dyeing results; but this is definitely not so. Numerous experiments have shown that the deeper shade is always obtained with the dye liquor prepared with ammonium sulfide. As a matter of

fact, ammonium sulfide leads to greater economy of dyestuffs than does sodium sulfide. It is therefore unfortunate that ammonium sulfide is a gas which forms an aqueous solution somewhat pungent in odor and volatile. Ammonium sulfide is also much more costly than sodium sulfide. Thus it is not generally practicable to employ this excellent reducing agent for large scale dyeing.

2. ANILINE BLACK DYEING

This very old fashioned method for producing a black on cotton goods is still very widely carried out, but only a comparatively few dyeing works are laid out with the necessary equipment; aniline black dyeing must therefore be considered as something of a specialty process.

As is well known, the dyeing process is carried out by padding fabric with a liquor containing aniline, hydrochloric acid, sodium chlorate (the oxidant), and copper sulfate (or other copper salt) or sodium ferrocyanide, and then ageing it in a hot moist atmosphere for development of the black color by oxidation of the aniline. Afterwards the fabric is generally treated with a warm sodium bichromate solution for the purpose of making the black ungreenable when exposed to reducing agents, particularly sulfur dioxide gas.

It will be understood from the above described dyeing process that there is considerable risk of tendering the fabric; cotton readily loses its strength when dried or heated with hydrochloric acid. Hence it is essential to control the dyeing process so that this adverse result is avoided. A satisfactory process of dyeing will now be described for cotton fabric.

(a) Dyeing of Cotton

For prussiate aniline black dyeing it is not only unnecessary to bleach the fabric but it is undesirable since the resulting small loss of strength produced by bleaching appears to be accentuated by the dyeing process. The cotton fabric is therefore merely scoured with a boiling dilute solution of soda ash in an open soaping machine and is then dried preparatory to dyeing.

The dyeing plant is shown in Fig. 1, and consists of two impregnating mangles, a small number of drying cylinders, a steaming chamber, an after-chroming plant,

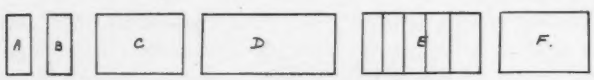

Fig. 1—Prussiate Aniline Black Dyeing Plant.
A—Padding mangle
B—Padding mangle
C—Drying cylinders
D—Steaming chamber
E—After-chroming plant
F—Drying cylinders

and a range of drying cylinders. Each impregnating mangle has two fairly soft rubber bowls and the trough containing the aniline black padding liquor is satisfactory resistant to corrosion if it is made of wood. The drying cylinders which following the impregnating mangles should be of copper, while the upper and lower guiding rollers within the steaming chamber should be made of the same metal. The steaming chamber itself is satisfactory when made of brick. The after-chroming plant consists of a number of wooden vats there being a pair of rubber squeezing rollers between each vat. The final drying cylinders may be of copper or tinned iron—it does not much matter since at this stage the fabric is free from corrosive chemicals.

The padding liquor should have the following composition approximately:

Aniline	58 lbs.
Hydrochloric acid of 32° Tw.	58
Sodium chlorate	34
Sodium ferrocyanide	47
Total volume	76 gallons

Two padding mangles are necessary although they both contain the same liquor (as indicated above) for thorough penetration of this liquor throughout the fibers is necessary for the production of a good deep black shade. As a matter of fact, the padding liquor contains a slight excess of aniline and it is found that this acts as a wetting-out agent. When fabric very difficult to penetrate is being dyed it may be found advantageous to add a small amount of Igepon T; this is one of the few wetting-out agents which is stable in a Prussiate padding liquor.

The cotton fabric leaving the padding mangles is slightly yellowish in color. As it passes over the drying cylinders it becomes more and more greenish, and on leaving the last cylinder (before entering the steaming chamber) it should be definitely greenish yellow and only just dry. The degree of drying is important since it is this factor which influences the final strength of the fabric and also the tone of black. If drying is carried too far then the fabric loses considerable strength—due to the action of the hydrochloric acid present. Also, if the fabric is left too wet then poor development of the black color occurs in the steaming chamber.

As might be anticipated, the conditions of humidity and temperature of the atmosphere within the steaming chamber must be carefully controlled. For this purpose it is well to have installed a wet-and-dry bulb thermometer. In most instances it will be found most suitable to have the temperature about 98 to 100° C. (dry bulb) and about 85 to 90° C. (wet bulb). If the rate of travel of the fabric through the chamber is adjusted so that the fabric takes about six minutes between entry and exit then the greenish yellow color should change to a deep black. On leaving the chamber the fabric should be completely dry.

At this stage the fabric has attained as deep a black shade as it ever will, but unfortunately it is very greenable. The after-chroming process is for the further oxidation of this shade, but on no account should this be carried too far. Excessive oxidation reddens the shade objectionably. The method here described is probably the most convenient for securing a degree of oxidation which is satisfactory. In the first compartment of the after-chroming plant is placed a cold ½% solution of sodium

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Recent Developments in the Chemistry of Silk and of Silk Processing--V

(Continued from page 332, June 4 issue)

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CHAPTER V
THE DYEING AND FINISHING OF SILK

DURING the period reviewed in this article there have been very few noteworthy contributions to the literature dealing with the dyeing, printing or finishing of silk. This indicates a lack of progressiveness on the part of the present-day silk dyers and finishers, and may explain, to some extent the sad condition into which this industry has now fallen. It will be seen that most of the recent additions to the knowledge of silk dyeing and printing have been contributed by dyestuff manufacturers who are interested in developing the sales of certain new lines of dyestuffs.

Silk Dyeing

All of the communications on this subject reflect the ever-increasing demand for greater fastness of colors on silk. Formulas have been developed for applying a large variety of vat colors to silk yarn, and the improved types of developed, or Naphthol, colors have also come into some favor on silk.

The Indigoid and Thioindigoid types of vat dyes are in general more suitable for dyeing silk than the Anthraquinone types, because the former may be reduced and dyed in less alkaline solutions than the latter. The soluble leuco forms of the vat dyes have a greater affinity for the silk if the solution is more mildly alkaline, and of course there is less danger of damage to the silk fiber. Various protective agents, such as glue, have been suggested for use in the vat dyebath, and it has also been proposed to replace the caustic soda by sodium phenolate or naphtholate.

There has been considerable experimentation on silk with the Indigosols. These soluble esters of the vat dyes should be particularly suitable for dyeing this fiber because they can be applied in an acid solution, and thus eliminate the disadvantages of the strongly alkaline dyebaths. The chief difficulty has been to find a suitable means of hydrolyzing these esters after dyeing, and thus restoring them to their insoluble form on the silk fiber. However, various agents have been adapted for this purpose and the Indigosols are becoming established as a factor in silk dyeing.

It has been found that certain compounds of copper or chromium with azo dyes are very well adapted for dyeing silk in a neutral bath or an alkaline bath up to about 10 pH. Soap furnishes a very satisfactory medium for producing the desired alkalinity. These metallic compounds are particularly recommended for dyeing weighted silk.

In dyeing mixed fabrics of silk and cotton or other vegetable fibers with direct colors the silk remains unaffected if the goods are first impregnated with a solution of a special benzidine disulfonate with or without formic acid. It is also claimed that silk is reserved in the dyeing of wool if there is added to the dyebath certain sulfonated unsaturated fatty, or hydroxy-fatty acids or their esters.

A recent patent states that the fastness of dyeings on wool or silk is increased by treatment before or after dyeing with a dilute aqueous solution of an organic derivative of ammonia, in which one of the radicals joined to the nitrogen atom is composed of a chain of not less than twelve carbon atoms: for example, octadecylpyridinium.

Silk Printing

In this field also considerable emphasis has been placed on the fastness of the printed colors. The compounds of copper or chromium with azo dyes (mentioned above) are said to be quite suitable for printing on silk when fastness to washing, as well as light, is desired. Chrome dyes may also be used to print fast colors on silk if to the printing paste is added an aliphatic polyalcohol, a substance of the urea group, or a sulfo derivative of the benzene or naphthalene series containing two hydroxyl groups.

Where fastness is not the prime consideration, a high percentage of the recent silk printing has been done by the discharge method. In this case the grounds are usually dyed with readily reducible direct colors, and there has been an ever-increasing demand for dyes of this type which may be completely discharged to as clear a white as possible. The direct colors are preferred to the acid colors for this purpose because there is no danger of their color returning after once being discharged.

Silk Finishing

Several recent patents deal with the modification of silk

with respect to its transparency, luster and feel. This is accomplished by first treating the silk with a swelling agent, and then washing. Suggested swelling agents are: (1) alkali hydroxide solutions of at least 20° Bé; (2) fairly concentrated sulfuric, hydrochloric or phosphoric acids; (3) ammoniacal copper oxide, and (4) concentrated solutions of chlorides, thiocyanates or other salts. A protective agent for the silk may be added to the treating bath.

Considerable attention has been given to the treatment of silk with an emulsion of rubber latex. It has been found that the coating of knitted silk articles with rubber latex is quite effective in preventing defects such as laddering. The latex may contain an excess of ammonia and may be vulcanized on the silk, or vulcanized latex may be used directly.

For many years sulfonated castor oil was commonly used in finishing when it was desired to impart an especially soft feel to the silk. Lately, however, this oil has in many cases been replaced by sulfonated olive oil, or special types of sulfonated mineral oils. The latter have the desirable property of being unaffected by long periods in storage. They are entirely free from the danger of developing a disagreeable rancid odor, which is sometimes found in the case of the former oils.

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G. P. 574,972, Apr. 21, 1933, I. G. Farbenind.
G. P. 575,135, Apr. 25, 1933, I. G. Farbenind.
G. P. 575,867, May 4, 1933, I. G. Farbenind.
B. P. 360,804, Apr. 27, 1931, I. G. Farbenind.
B. P. 366,963, Sept. 30, 1930, I. G. Farbenind.
B. P. 366,987, Sept. 30, 1930, I. G. Farbenind.
B. P. 368,667, Oct. 31, 1930, I. G. Farbenind.
B. P. 384,247, Dec. 1, 1932, I. G. Farbenind.
B. P. 387,890, Feb. 16, 1933, I. G. Farbenind.
B. P. 394,212, June 22, 1933, I. G. Farbenind.
Swiss P. 161,539, July 17, 1933, S. Rossi.
U. S. P. 1,913,487, June 13, 1933, I. G. Farbenind.
U. S. P. 1,934,413, Nov. 7, 1933, G. J. Esselen.
U. S. P. 1,936,753, Nov. 28, 1933, Dreyfus and Miles.

(Continued on page 363)

PROCEEDINGS OF THE
American Association of Textile Chemists and Colorists

JUNE 18, 1934

Officers of National Association

ROBERT E. ROSE, *President*
E. I. Du Pont de Nemours & Co., Wilmington, Del.

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National Aniline & Chemical Co., Boston, Mass.

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LOUIS A. OLNEY
Lowell Textile Institute, Lowell, Mass.

Council Representatives: Northern New England—Roland E. Derby, New York—Hans Meyer, Philadelphia—Harold B. Dohner, Midwest—Carl E. Bick, South Central—G. H. Dubois.

Local Sections and Their Officers

Northern New England Section
Leverett N. Putnam, Chairman, Worsted Division, Pacific Mills, Lawrence, Mass.
Clarence L. Nutting, Secretary, Arlington Mills, Lawrence, Mass.

Rhode Island Section
Heyward F. Lawton, Chairman, Borden & Remington Co., Providence, R. I.
C. Brian Wainwright, Secretary, Apponaug Co., Apponaug, R. I.

New York Section
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Harold Schroeder, Chairman, Dixie Mercerizing Co., Chattanooga, Tenn.
Harvie Bruce Kimbell, Secretary, Dixie Mercerizing Co., Chattanooga, Tenn.

Midwest Section
Eric F. Hempel, Chairman, National Knitting Co., 2165 South First Street, Milwaukee, Wis.
Elmer F. Smith, Secretary, American Aniline Products, Inc., 820 S. Clinton St., Chicago, Ill.

South-Eastern Section
Charles B. Ordway, Chairman, Alabama Polytechnic Institute, Auburn, Ala
C. A. Jones, Secretary, Georgia School of Technology, Atlanta, Ga.

Lowell Textile Institute Student Section
Raymond L. Matthews, Chairman; Charles L. Daley, Secretary.

North Carolina State College Student Section
H. S. Bliven, Chairman; D. B. Hardin, Secretary.

Members should notify the **Secretary** immediately of all address changes

MEETING, NORTHERN NEW ENGLAND SECTION

A REGULAR meeting of the Northern New England Section was held Friday, May 4th at Riverbank Court, Cambridge, Mass. attended by forty members and guests.

Following the usual dinner, a short business meeting was held during which the Nominating and Outing Committees' reports were received. Plans were concluded for the annual outing to be held Friday afternoon, June 8th at the Andover Country Club.

At the conclusion of the business session, the subject "Dry Carbonizing by Hydrochloric acid Gas" was treated in two papers presented by Mr. William Brandy and Mr. Frank Burnham.

To Mr. Brandy's treatment of the subject from a practical production man's point of views, Mr. Burnham added a discussion of the technical aspects involved when this process is applied to shoddy manufacturing. During the discussion which followed, Mr. Hedenburg of the Gordon and Gordon Co. who was present by invitation, briefly discussed the advantages of this process for treating burry virgin wool for woolen and worsted manufacture.

The remarks of the speakers brought forth many questions and comments which indicated much interest in the subject. Respectfully submitted,

CLARENCE L. NUTTTING,
Secretary, N. N. E. Section.

MEETING, MIDWEST SECTION

A MEETING of the Midwest Section was held at the Schroeder Hotel, Milwaukee, Wisconsin, on Saturday, May 5th.

The meeting was opened at 8:40 P. M. by Chairman Eric F. Hempel.

Mr. Arthur Brainerd was duly elected as a member from this section for the nominating committee for National Officers.

Chairman Hempel quoted Article II of the Constitution of the Association and commented on the practical benefits to be derived by members giving heed to the objects of the Association.

Mr. Virgil T. Hartquist, of the Wayne Knitting Mills, Ft. Wayne, Ind., gave a paper on "Degumming of Silk Hosiery."

There being no further business to come before the meeting, Chairman Hempel adjourned the same at 10:15 P. M. Respectfully submitted,

ELMER F. SMITH, *Secretary, Midwest Section.*

Proceedings of the American Association of Textile Chemists and Colorists

Haveg in the Textile Industry*

By **WILLIAM H. ADAMS, JR.**
of the Haveg Corporation
***and* WILLIAM E. H. BELL**
of W. H. Butterworth & Sons Company

DURING the past fifteen or twenty years there has been a very marked progress, both here and abroad, in the manufacture of dyestuffs for wool and silk fibers. There has also been, of necessity, a corresponding progress in the technique of dyeing animal fibers. Twenty years ago the colors then available could be handled by the rough methods then in use without abnormal difficulties. With the present delicate shades of pink, blue, yellow, etc., accurate results can only be obtained by the most precise and skillful work, aided by a number of different types of specialized dyeing machines, made for this specific purpose.

The results which have been obtained have been restricted, however, by the fact that materials of construction have not, until recently, kept pace with the rest of the art. Until a short while ago the dyer has been restricted to wood and certain metals in his dyeing machines and equipment. Because of inherent difficulties connected with such materials, the dyer has not been able to achieve the optimum results.

Nearly all dyeing of animal fibers is done under acid conditions—sometimes very strongly acid conditions. Furthermore, the dyebaths are usually very hot. Under these conditions, it is not surprising that the old-fashioned wood tub has given trouble. Hot acid readily attacks the lignin of the wood and after a relatively short period it becomes soft and presents a scaly fibrous surface from which splinters easily break off. In addition to this difficulty, wood absorbs appreciable quantities of the dye liquor. Should it be desired to change a machine from one color to another, this can only be done after a careful boil-off, and even then contamination of succeeding colors is a frequent and irritating source of off-shade goods.

In regard to metal machines, it is, of course, obvious that a normal iron or steel tub would be eaten to pieces in a very short while, under the severely acid conditions which obtain. To overcome this a very large number of special acid resisting alloys have been proposed from time to time, the best of which are excellent corrosion resistant materials. It has been found, however, that with many of these metals there has been, with certain dyes, a distinct color change and a material detraction from brilliancy and depth. This effect may be due to almost microscopic traces of metal dissolved in the solution, or it may be due to a catalytic effect of the metal on the dyestuff itself. In any event this has been a serious factor with the delicate shades now in such demand.

A further difficulty with metal in dyebaths is the fact that there is grave danger of electrolysis, with a host of attendant troubles not the least of which is the danger of structural breakdown of the tub itself.

Frequently, also, scums and scales form on such surfaces, partly precipitates from the dye and partly animal oils from the goods; in metal tubs with high heat conductivity, they may even be baked on and become very difficult to remove. The scale frequently marks the goods wherever contact occurs, and provides also localities where electrical couples may form, enhancing the danger of electrolysis.

The ideal material for use in dyeing equipment, must therefore, be almost perfectly non-absorptive to dye liquors, must be smooth, and must not contaminate the dye solution even with traces of anything likely to affect the shade of the goods; must not be subject to electrolysis; must be resistant to temperature changes; must have low conductivity; must not be affected by nor form hard scale with anything used in the dye liquor; and must be mechanically strong.

In 1922 a German company was incorporated under the name of Säureschutz Gesellschaft, primarily, as the name suggests, for the development of materials which afford protection against acids. After several years of research and development, a product was offered under the trade name of Haveg, the properties of which were so close to the ideal that it had almost immediate acceptance as a construction material in the European textile and chemical industry.

The reasons for the superiority of Haveg as a constructional material for chemical and textile uses are to be

* Presented at meeting of Philadelphia Section, March 2, 1934.

found in its chemical and physical nature. It consists essentially of a thoroughly matted mass of asbestos fibers, bonded together by a synthetic resin of the phenol formaldehyde type and hardened by heat and pressure. Asbestos has long been recognized as a good acid resistant material.

Phenolic resins are among the most inert organic substances known. They are almost completely non-absorptive and are unaffected by water and most acids. They are hard and smooth and neither rapid temperature changes nor continued exposure to temperatures up to 135° C. have any effect on them. Furthermore, they are excellent electrical insulators. Naturally, the combination of these two materials partakes of all these desirable properties, and in addition, the asbestos fibers, interlocked in the mass, provide considerable mechanical strength and shock resistance.

From the standpoint of dyetub construction these properties mean that Haveg is completely unaffected by the acids used and can neither contaminate the solution nor itself corrode; that it cannot absorb dyes and thereby cause off-shades; that, being an insulator, it is completely free from the danger of electrolysis, and that having low heat conductivity and a smooth surface, it does not permit the formation of hard baked-on scales. Haveg can actually be flushed clean with a hose.

The question naturally arises, since the resistance of the basic materials in Haveg has long been known, why no commercially successful constructional material involving them has been developed before. There are several reasons for this. Phenolic resins alone are of very limited applicability because of their weakness and it has been necessary to reinforce them by means of other materials to lend them strength and toughness. While asbestos has been used for this purpose in a limited way, the usual type of filler has been some form of cellulose, such as paper, canvas, woodflour, and the like. Cellulose is not completely resistant to acids, with the result that such compositions frequently failed where extremely corrosive conditions obtained.

Perhaps an even more important difficulty was the fact that until now such materials have been restricted either to flat sheets and special shapes, or to various molding powders destined to be formed in expensive dies. It was impractical to attempt to build tanks and large equipment out of sheets because of the constructional difficulties and the cost. The molding powders required forming dies which even for small pieces ran into considerable figures and which could therefore only be used where a very large number of identical pieces was contemplated. It was obviously absurd to try to make one or two tanks or tubs seven or eight feet in diameter with this type of product. The cost of molds for such an object would have run into many thousands of dollars.

With Haveg, however, an entirely new process of molding has been found, which eliminates this tremendous mold expense, and which makes it possible for the first time to utilize the very desirable qualities of phenolic resin on a commercial scale. It is now possible to make large units of factory equipment in a single piece, without seams or joints, and at a cost entirely within commercial practicability. It is even possible, for instance, to mold a tank, 9 ft. in diameter and 9 ft. deep, containing 4,200 gallons without a seam or joint in it anywhere. This fact, together with the known chemical resistance of the material, is the reason for the wide acceptance of Haveg, both here and abroad.

It should be stressed, of course, that Haveg is not a cure-all, and should be used with due regard to its properties. Fortunately, the many different applications abroad provide a background of experience both in matters of design and chemical usage, so that very accurate predictions of performance can be given.

Thus it can be said that Haveg is resistant to practically all acids except oxidizing acids. It will withstand hydrochloric acid in any concentration, even at boiling point, and sulfuric acid up to 50%. It will withstand phosphoric, oxalic, acetic, formic, lactic—in fact, practically any acids except the oxidants, such as nitric acid, for instance.

With dilute nitric acid some successful applications are on record, but due to the fact that the resin is an organic substance, it is attacked by the oxidizing action of this material in the higher concentrations, and general use cannot be recommended.

Concentrated sulfuric acid and chromic acid in the higher concentrations are other examples of oxidizing agents with which the use of Haveg is not ordinarily considered desirable.

Haveg is resistant to a large number of other chemicals besides acids. Thus most of the salts and the weaker bases such as lime, sodium carbonate and ammonia, can be used without fear. Haveg is unaffected by gasoline or hydrocarbons, oils, carbon tetrachloride, etc., but acetone and a few other similar solvents have a swelling action. Chlorine gas and chlorine water have no effect on Haveg, but bromine and iodine cannot generally be used. Most of the bleaching agents can be used without danger in Haveg equipment, with the exception of sodium hypochlorite, which attacks the material when used in strong solutions. Finally, Haveg should not be used with strong bases such as sodium and potassium hydroxide, nor with aniline, pyridine, or similar organic bases.

In the textile field at one time or another, acids, bleaching agents, agers, oxidants, reducers, and many other chemicals are used, frequently several at the same time. The action of a mixture of this type is not always predictable from the action of the individual components.

This might introduce complexities were it not for the fact that there is a rule-of-thumb method of determining the suitability of Haveg in practically every individual case. This is as follows: if wool or silk fibers or fabrics can be handled in a given solution without damage, Haveg equipment can safely be used for that operation.

In regard to mechanical design, there is a wealth of experience both here and abroad from which to draw. The question of Haveg design is really rather a simple one, when the nature and properties of the material are thoroughly understood.

The essential facts are that Haveg is a plastic, not a metal, and that it is a constructional material, not a lining. This means that tubs, tanks, towers, etc., can be made from Haveg itself. With the proper wall thicknesses the strength of such equipment is adequate without the necessity of internal reinforcement, and this means that the acid resistance is the same throughout the entire mass. No concern need, therefore, be felt if surface damage occurs. This means also that alterations or repairs can be made, sometimes even right on the job, as the new surfaces thus exposed are just as resistant as the old. A significant property of Haveg is its low thermal conductivity. This means that heat losses are low and in general it is hardly necessary to lag Haveg equipment to prevent heat loss; also its coefficient of expansion is low; this means that it is not subject to breakage due to rapid temperature changes.

In a great many cases, where pressure is involved, where the possibility of mechanical abuse is great, and in general where severe conditions obtain, external metal reinforcement is used with Haveg.

In the case of simple cylindrical tanks, this reinforcement takes the form of metal bands, or wooden staves together with metal bands. Rectangular tanks usually have an external rib structure or a cast false work or frame. In extreme cases it is even possible to use a continuous external shell surrounding the Haveg tank.

Haveg, is of course, not restricted to simple cylindrical and rectangular tanks. Very many other and more complicated apparatus has been made. In fact, almost any type of equipment is possible of fabrication.

In the chemical field, drying trays, filter plates and frames, reactors, fractionating towers, washing towers, storage tanks, pickling tanks, electrolytic tanks, agitators, pumps, cocks and valves, fans, pipe, fume systems and many other types of equipment have been supplied.

In the textile field, buckets, dippers, storage and reaction tanks, pumps, pipe and valves, etc., are available for diverse dyeing, bleaching operations, etc. Acetic acid and other agers can be constructed even in very large sizers. Then there are the many types of specialized dyeing machines, such as piece dyeing machines, rotary skein machines, circulating skein machines, raw stock machines, various types of bobbin and package machines, which are invaluable for wool and silk dyeing.

As stated above, Haveg is not a cure-all. But when used under the proper conditions and with a due regard for its properties, results are obtainable in textile and dyeing uses which have long been awaited, and its increasing use is undoubtedly a contributing factor in the recent improvement in wool dyeing here and abroad.

Discussion

Mr. McNamara: What is the resistance of this material to weak boiling mixtures of bichromate and sulfuric acid?

Mr. Adams: It is satisfactory. If the concentration is very high, you could get an oxidizing action from the chromic acid; but if you have sufficient oxidizing action to injure Haveg, it would also injure the goods, so that, as far as textile use is concerned, it can be stated that such a mixture is O.K.

Mr. McNamara: If there is any damage, would that result in flaking of the material?

Mr. Adams: No, there is not. The only effect you would notice is that if you used, for instance, concentrated nitric acid, you would form nitrates of the phenol resin, some of which are soluble; the main effect would be simply a roughening of the surface. You wouldn't notice any flaking or splintering, even if there was an effect on the material.

Mr. Fish: Is the average thickness the thickness of these samples?

Mr. Adams: The thickness depends entirely on the job at hand. Perhaps, I can illustrate it by a specific example. I mentioned a nine-foot cylindrical tank. The wall thickness is about 1¼ inches and the bottom is about a quarter of an inch more. Smaller tubs would have a minimum of about five-eighths of an inch.

Q.: What is the average life of Haveg?

Mr. Adams: To all intents and purposes, indefinite. I saw one when I was in Germany a year ago, in operation, which was the first rectangular tank ever made. It was still in operation after seven years, and seemed to be O.K. If the thing is not abused, and if it is handled with reasonable care, it should last for years and years.

Q.: You say that the tank is not moulded—how do you arrange for the corners?

Mr. Adams: It is moulded; but by what I would call a trick process; the corners and sides have a fillet where they join the bottom.

Mr. Stringfellow: How does that compare in price to the other materials used for that purpose?

Mr. Adams: It is, of course, higher than wood. On the other hand, in most cases, it is of about the same price as a good acid resisting tub.

Mr. Stringfellow: If it is not taboo to mention it, how would it compare, for example, with Monel metal?

Mr. Adams: I am going to ask Mr. Bell to answer that because it is in his department.

Mr. Bell: It does compare with Monel or stainless steel, or any of the better known similar metals. The cost of Haveg compares very favorably. Don't misunderstand me; I don't mean we can take a wooden tub and put a Monel metal lining in it, and better that. But, with some self-supporting metal, something of sufficient weight so that it does not require a wooden tub around it to support it, the comparison is very favorable.

Mr. Stringfellow: From the standpoint of deterioration, due to causes such as acid, alkalis, etc., how does it compare?

Mr. Bell: If you will be kind enough to make that comparison, at least two to one. The first that was built is still in operation and shows no appreciable signs of deterioration. It indicates that the life might very reasonably be two to three times the seven-year period that is past. We also know generally, the life of Monel or other metal construction. It depends largely on the use it is put to; the acids that affect it and the possibility of expansion and contraction. There are many other factors that affect metal structures.

Mr. Adams: It has been asked me several times, what I mean by "resistant," when I am speaking. I mean that there would be no effect. I don't mean, just some effect, I mean none at all, because plenol resin is absolutely unaffected by acid in most of its forms.

Mr. Dohner: You speak of the fact that acetone affected it. Suppose you had a solution of 1% of acetone, would that affect it?

Mr. Adams: I would say no, that it would not. We frequently run across cases where it is very difficult, from our experience, to state definitely what will happen, because the conditions will determine this. The best thing to do is to try a sample.

Mr. Dohner: Suppose it was in connection with another solvent?

Mr. Adams: I doubt whether there would be any effect. Even if it did, the acid resistance of the tub is the same throughout, so that it should not have any serious effect.

Mr. Dohner: How does it compare with glass lined tanks?

Mr. Adams: That is largely a question of size, and the largest size Haveg would be considerably cheaper.

Mr. Stringfellow: Mr. Adams, granted that Monel metal has its disadvantages, for example, in a cotton dye house. It isn't foolproof—neither is Haveg foolproof. Suppose you were dyeing the ordinary range of colors for cotton from the cheap direct to vat colors, you would have to use more than reasonable precautions in a Haveg tank.

Mr. Adams: Those precautions should normally, I think, take the form of consulting us before the equipment is actually used.

Q.: Particularly in the case of vat colors?

Mr. Adams: Yes. In connection with caustic, we have also, the fact, as I stated in my earlier discussion, that we do not recommend it for use with strong alkalis. But, in several cases, customers are using Haveg with caustic successfully. It is usually in rather low concentrations. Sometimes there are also other materials present.

Q.: Is it sensitive to diazo salts?

Mr. Adams: It would depend probably on the diazo salts. That is a case on which I could not make any definite recommendation. It would be wiser to try it out.

Q.: Has this material any effect on colors?

Mr. Adams: It has none. There is nothing there that could cause it. There is nothing to go out into the dye solution that would have any dulling effect, nor is there any metal present which would have a very pronounced effect. You can dye just about as true in a Haveg tub as you can in a laboratory.

Q.: Is this material easily shattered?

Mr. Adams: No. It is, of course, possible to damage it by a severe blow; but it can take a terrific beating before anything could happen. Since we have been in operation, one tank was dropped from a crane in transporting and the bottom was smashed. We can take such apparatus back to the factory, even with the whole bottom out, and mould a new bottom into it.

Q.: I had in mind more particularly, the workmen in a dye house; if they happened to be wheeling a truck and hit the machine.

Mr. Adams: No. It would be possible to break it with a terrific blow, but we protect it from that, by placing a metal frame around it. It would have to be an awful blow, to cause any serious damage.

Mr. Bell: That is the difference between the American design and the German. A German is much more methodical and careful. There is little likelihood of damage to it; but we recognize that sometimes, our boys are a little rough so we build a frame around it to protect it.

Q.: Are the pipe connections into the tanks moulded in?

Mr. Adams: That is possible. It has the disadvantage of making the job non-demountable. Usually what we do, is either to mould a flange right in the mass of the Haveg, or mould a nipple, and then make the connection according to one of those methods I showed you with a rubber gasket between. The gasket would not have the resistance that the Haveg would; but it is only in contact in a very small area. We have found that very satisfactory.

Mr. Echells: How does it work with hydrogen peroxide?

Mr. Adams: That would be all right. There are quite

(Continued on page (187) 351)

Proceedings of the American Association of Textile Chemists and Colorists

Fastness of Dyestuffs

Alone and in Combination

By **P. H. STOTT**
E. I. du Pont de Nemours & Co., Inc.

ALMOST every user of dyestuffs is interested to some extent in the fastness properties of the colors he uses. In some cases the demands made are very small and can easily be satisfied. In other cases the demands are very exacting, and can only be met by a thorough knowledge of the fastness properties of the colors available as applied to the particular case. The term "fastness" really does not mean anything unless used in relation to some specific need. It also does not necessarily apply solely to the demands made by the ultimate consumer of the colored material. The processing of certain textiles involves at times some rather severe chemical and physical treatments to obtain specific results. As examples we may quote kier boiling and bleaching as used in processing cotton, and fulling and carbonizing as used in processing wool. These operations have no direct interest for the ultimate consumer whose major interests in fastness can in broad terms be interpreted as restricted to light and washing with perspiration, salt water and a few others, falling in the category of comparatively limited interest. The layman's judgment of fastness is not based on the same sound fundamentals that the expert uses to form his opinion. A distinct change in shade will invoke more criticism than a loss in depth of shade which is not accompanied by such a change. For instance, a brown which turns noticeably towards blue or red on fading, even though there is not much less in actual depth will be likely to cause more comment than a similar brown which loses say 30 per cent in depth, but still retains its original brown tone, or even turns towards the duller or "blacker" side.

The demand for colored goods of high quality has necessarily been the cause of a tremendous amount of investigational work. This is true not only of the converter but of the dyestuff manufacturer, and in some cases the merchant has contributed his part. Our own Association, co-operating with all three, has as you know created many committees to investigate and recommend standardized methods to determine fastness properties. These methods are based on the knowledge and experience of the best minds in the profession and are designed to meet the requirements of the converter as well as the consumer. As you know, the findings of the committees are published in the Year Book and the criticism and comment of every member is invited and expected in order that this field be completely and exhaustively covered.

The dyestuff manufacturer's problem does not end with the making of the dye. In fact it really is just beginning to a large extent, for in order to determine whether the newly created color is of any commercial value it must be subjected to all sorts of fastness tests and application methods, in comparison with existing colors of known value. This means that at some time or other every dyestuff has been thoroughly evaluated and the results carefully tabulated and classified. The Technical Laboratory of the du Pont Company has evolved its own methods of tabulation and classification and to give you an idea of the comprehensive nature of the work done I would like to call your attention briefly to this strip of cloth which shows the results of part of the investigation made on all colors. From tests such as this the information given in our circulars and color cards is taken. However, this only represents part of the work necessary. I can think of no better illustration of some of the other work involved than to refer you to the December 18 and January 1 issues of the "American Dyestuff Reporter," which contain a paper by Mr. C. A. Seibert on "The Rate of Absorption and Affinity at Different Temperatures of Substantive Dyestuffs when Applied to Cotton and Rayon."

The data presented in this paper necessitated the preparation of some 8000 dyeings as well as the evaluation and classification of them. This, as you can readily see, represents a tremendous volume of work and painstaking en-

*Presented before Piedmont Section, Jan. 27, 1934.

deavor, and should give to the thoughtful individual information which should be invaluable in the practical application of color. It is very simple to draw a parallel between the value of the information given in this paper and that of a knowledge of fastness properties of colors alone and in combination with others. A careful study of the classifications of affinity will indicate readily those colors which will work well together under smilar conditions. So if your problem is one of uneven dyeing, ending of warps, or pieces, shading from selvage to selvage I venture to state that you will find at least a part of the solution by reference to the tables given. You will probably find that you are unwittingly using colors of different affinity or absorption rate. You will also find that many other colors are available the use of which will probably go a long way towards solving your problem.

Now, what is true of application properties is also true of fastness properties. By that I mean to say that if you are to avoid changes in shade you must select colors having very nearly equal fastness to the particular requirement and obviously in order to be able to do this you must base your selection on tests made under similar conditions. Even exercising this care there are still pitfalls to be contended with. In a paper as brief as this one necessarily is, it is obvious that we can do no more than indicate some of the more important features necessary to consider and for this purpose possibly the matter of fastness to light may be regarded of major importance. We might extend this a little and consider fastness to outside exposure as well. You will notice that a distinction is made between the two and I will endeavor to point out that there are important differences.

Upon the nature of the fabric and the specifications of fastness placed upon it depends the selection of color used for dyeing it. There are available the following important classes of dyestuffs for dyeing cotton:

1. Vat colors
2. Azoic colors
3. Direct colors
4. Sulfur colors
5. Developed colors

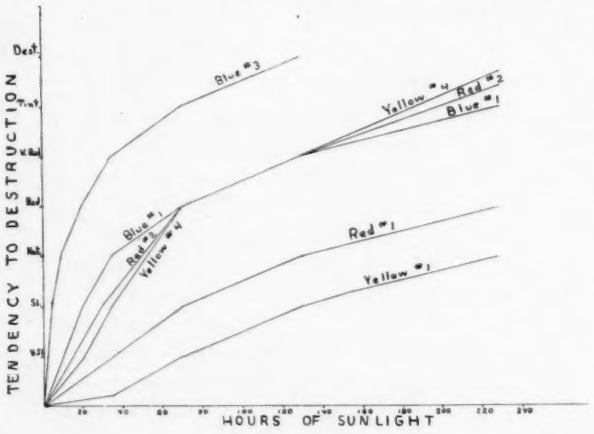
As in all other groups of dyestuffs the fastness varies tremendously between members of the individual groups. It is a mistake to specify that a piece of material should be dyed with vat colors and expect maximum fastness because some of the fast to light direct colors are actually faster to light than some of the vat colors, and while they may not suffice in other directions, such as fastness to bleaching, they nevertheless answer admirably for such materials as draperies and upholstery cloths which are seldom washed vigorously. Certain of the azoic colors possess excellent resistance to light and other characteristics which broaden the possibilities of their use. Sulfur and developed colors are mainly recommended for their better than average fastness to washing although some of them have good light resistance also. In view of this array of color possibilities how are we going to decide what group of colors to use? Obviously our basic selection must be made on at least the following:

1. What is expected of the material
2. What cost is permissible to produce it.

These two must be in agreement or nothing further can be done. If we are only allowed 5c a pound to produce a medium shade intended for an awning stripe requiring 10 lbs. of color at $1.50 a pound, we obviously can not do much about it. On the other hand if we are asked to produce a black fast to certain specifications of washing for shall we say 3c a pound, we have at least two possibilities. Ordinary direct black aftertreated with formaldehyde has quite good fastness to washing for the first two or three washings and might answer—if not we can resort to the use of sulfur black. However, we must know what is expected of the material before we can make the most intelligent selection from all standpoints. These two very simple examples merely serve to point the way to some statements I wish to make on observations made by others as well as myself on fastness to light and weather, which will be quoted with the object of emphasizing the importance of careful selection of color.

The work of our Association sub-committee on fastness to light has been previously referred to and as you know the results have been published in the proceedings of the Association. Various papers have been presented from time to time and every dyestuff supplier issues color cards classifying the fastness of colors offered for sale. Various systems of classification have been used and perhaps the most common is that of using numbers. In some cases the number 1 indicates the best and 5 the poorest—in other cases 1 is the poorest and 8 the best. It would be simpler if all systems were based on the same foundation, but as long as the necessary explanations are given it probably is not essential. All of these data are designed to help the user of color in a selection of not only the fastest colors but also those of comparable fastness so that they can be used in combination, with reasonably good results. The work of the various committees, research organizations and individuals will probably result ultimately in the development of a scheme whereby the fastness properties of all dyestuffs will be relative. By that I mean to say instead of dyestuffs being grouped according to color and their fastness rated comparatively in each group, they will be regarded as a whole so that a yellow with a specific rating will exhibit about equal fastness as a blue with the same rating. As matters stand at

present there is no surety that a yellow rated as 1 and a blue rated as 1 have equal fastness. They may be the fastest of the yellows or the blues, but if used in combination the yellow may outlast the blue and in order to produce a combination which will fade without changing tone, it may be necessary to resort to the use of a yellow



of a lower rating than the blue. I have attempted to illustrate this important feature graphically. You will see that Blue No. 1 (the fastest of the blue group) does not compare in fastness with Yellow No. 1 (the fastest of the yellow group) nor with Red No. 1 (the fastest of the red group.) We have to go pretty far down the scale in the yellow group to find a suitable color and finally select Yellow No. 4 and Red No. 2. These fade very nearly similarly to each other and to Blue No. 1 so we should have a suitable combination as far as change of tone is concerned. We could find more and similar instances but must pass on to other features which are considered of interest.

It sometimes happens that two or more colors dyed in combination seem to influence one another's fastness properties. There are several classic examples of this feature with which you are probably acquainted. Anthraflavone as a self color has relatively poor fastness to light, but greens made from it and Blue GCD, which has excellent fastness, are of comparatively good fastness. I am going to refer you at this point to papers which have been published in the proceedings of our Association. "Abnormal Fading" by Mr. W. H. Cady (January 19, 1931) and "Some Observations on Light Fastness" by Mr. J. W. Russell (July 4, 1932). Both these papers are full of valuable information and will bear re-reading and studying carefully.

In Mr. Russell's paper a very excellent resume of results obtained by testing vat colors alone and in combination is given with explanations and remarks by the author. The chart accompanying the paper serves as another illustration of unanticipated results and is most educational.

All of these data from various sources point in two very important directions. First, the desirability of establishing a standard method of testing so that all colors will receive comparative evaluation, and second, the absolute necessity of submitting to actual test any combinations which may be used in the duplication of any shade. These tests should be made under conditions duplicating as nearly as possible the conditions to which the goods will be exposed. It should not be taken for granted that combinations of colors will give results equal to their individual components nor will the results of exposure in one climate necessarily be duplicated in another.

There is probably no better illustration of this possible than to give you a few of my experiences in testing awning fabrics. The dyeing of yarns which are subsequently to be woven into awnings presents possibly the most difficult problem which the dyer and dyestuff manufacturer have had presented to them, I mean from the standpoint of color selection and color constitution. The colors, to be of value, must resist extraordinarily severe conditions. As distinct from a piece of dress material or upholstery cloth, an awning's life is spent entirely out-of-doors, without much, if any, protection from hot sun, rain and wind. A cooling shower on a hot summer day usually brings relief to suffering humanity, but it brings no relief to the color in the awning—quite the reverse is true, because the rain dissolving, as it does, chemicals from the atmosphere brings these into contact with the color and frequently they are of a nature which will affect the color, as one chemical compound will affect another. The constant friction of small particles of dust blown by the wind across the surface of the awning also causes erosion of both color and fabric. The ultra violet rays present in sunlight and which do not pass through most types of window glass have every opportunity to work on the color in an awning. Awnings which are hung in or near industrial centers naturally suffer a great deal more from dissolved chemicals, chimney dirt and other forms of industrial waste, than do those which are exposed in the clear country atmosphere.

This, of course, is probably old news to you men, and I quote it merely to illustrate one or two points:

First: A dyestuff rated fast-to-light under glass does not mean that it is suitable for awning yarns.

Second: It is extremely difficult, if not impossible, to find a satisfactory laboratory method of testing whether or not a dyestuff is suitable for awnings. This, of course, is apparent because of the difficulty of duplicating atmospheric conditions artificially.

Third: A standardized test similar to the ones sponsored by the A.A.T.C.C. would perhaps not be of much

value because of the wide variation obtained from exposures in different atmospheres.

It is then obvious that the selection of dyestuffs for awning yarns is dictated by their fastness to outside exposure in a variety of atmospheric conditions and how best to determine which colors are most suitable, can only be accomplished by painstaking investigation.

Preliminary tests having eliminated all the unsuitable colors much more comprehensive tests must now be made to determine the most suitable ones, and in this scheme the following points must be covered:

1. Tests as self colors
2. Tests of combinations of colors
3. Tests in different localities.

Naturally it is necessary to cover as many different types of exposure as possible ranging from an industrial center such as Pittsburgh to the residential section of a non-industrial town. I can best illustrate the necessity of this procedure by giving you a few results of exposures which have been made under such varying conditions.

Orange (Vat color)

Boston—Considerably bluer and dirty.
San Francisco—Very slightly faded.
Philadelphia—Slightly bluer.
Charlotte, N. C.—Very slightly faded.

Light Blue (Vat color)

Boston—Much greener.
San Francisco—Considerably greener.
Pittsburgh—Slightly greener, very dirty.
Newnan, Ga.—Considerably greener and lighter.

Green (Vat color)

Boston—Slightly bluer.
San Francisco—Considerably bluer.
Pittsburgh—Slightly faded, very dirty.
Newnan, Ga.—Badly faded.

As a comparison exposures made at the same time using mineral colors furnishes interesting information and the results are tabulated below:

Chrome Orange

Boston—Entirely destroyed.
San Francisco—Very much greener.
Pittsburgh—Not much shade change; very dirty.
Newnan, Ga.—Very slight fading.

Light Iron Buff

Boston—Badly faded to gray.
San Francisco—Slight fading; dirty.
Pittsburgh—Somewhat faded; very dirty.
Newnan, Ga.—Very slight fading.

Chrome Yellow

Boston—Much greener and duller.
San Francisco—Considerably greener.
Pittsburgh—Much greener; very dirty.
Newnan, Ga.—Greener.

Surely one could not ask for better evidence in favor of exposures under varying conditions as these results show. In the case of the mineral colors the reasons are perhaps not so hard to find. The humid atmosphere of

(Continued on page (189) 353)

TABLE SHOWING FASTNESS OF COMBINATION DYEINGS

Light Exposure August 15 to November 30, 1930

	Fastness Alone	Brown G	Brown R	Jade Green	Grey RRH	Orange RK	Orange RRT	Red BN	Scarlet R	Violet BN	Violet RRNX	Anthraflavone	Yellow G	Blue GCD	Blue RCX	Blue 3G
Fastness Alone	E	E	G	G	E	G	P	E	G	G	E	P	P	E	E	E
Brown G	E		E	P	E	E	G	E	G	G	E	P	F	G	G	G
Brown R	G	E		P	G	G	F	E	G	F	G	P	F	F	F	P
Jade Green	G	P	P		E	G	P	P	G	E	G	P	P	E	E	E
Grey RRH	E	E	G	E		E	E	E	E	E	E	G	G	E	E	E
Orange RK	G	E	G	G	E		G	E	G	E	G	F	F	E	E	E
Orange RRT	P	G	F	P	E	G		E	G	G	G	P	F	E	E	G
Red BN	E	E	E	P	E	E	E		E	E	E	G	F	E	E	G
Scarlet R	G	G	G	G	E	G	G	E		E	E	F	F	E	E	E
Violet BN	G	G	F	E	E	E	G	E	E		E	P	G	E	E	E
Violet RRNX	E	E	G	G	E	G	G	E	E	E		P	F	E	E	E
Anthraflavone	P	P	P	P	G	F	P	G	F	P	P		P	F	F	F
Yellow G	P	F	F	P	G	F	F	F	F	G	F	P		E	E	G
Blue GCD	E	G	F	E	E	E	E	E	E	E	E	F	E			
Blue RCX	E	G	F	E	E	E	E	E	E	E	E	F	E			
Blue 3G	E	G	P	E	E	E	E	G	E	E	E	F	G			

E = Excellent G = Good F = Fair P = Poor

Proceedings of the American Association of Textile Chemists and Colorists

Kier Boiling*

By JOHN BOTHAMLEY
Arkansas Co., Inc.

IN COMPLYING with the request of your chairman, Mr. George P. Feindel, I am to speak to you briefly on the Preparation of Cotton Piece Goods Prior to Kier Boiling, and at the same time to speak on Kier Boiling Preparatory to Chlorine Bleaching. Therefore, don't let anything that I may say become confused with the preparation for peroxide bleaching of colored striped fabrics, because we have in mind the production of solid whites only, and this covers whites for bleached piece goods as well as whites that have to be subsequently piece dyed or printed.

Let me begin by saying to those of you who can oxidize your goods with one hundred and fifty titration or one-half of one degree twaddle chlorine in one hour, that I have no message, because your bleach is perfect. To those of you, however, who are using strong chlorine, saye one degree twaddle and up, to get good oxidation I think you may be interested in what I have to say because it is very evident your goods are not bottomed, in other words, the prepare and boil has not liberated all the oils and waxes the fiber originally contained. In addition to the oils and waxes we must also eradicate the starch that surrounds the warp.

On plain white work, the bleacher by increasing his chlorine strength can oxidize goods that have been imperfectly boiled, but that does not alter the fact that the goods are not bottomed and will turn yellow on storage, for which the softener is frequently blamed. In bleaching for printing and dyeing, it is vitally necessary to extract all the foreign matter from the fiber so that the goods may be thoroughly absorbent and will dye or print readily as the occasion calls for.

In order to accomplish this result we must find some method of improving the circulation of the liquor in the kier and of getting the caustic liquor through the goods faster. The starch that surrounds the fiber collected in the slasher box in sizing of the warp is probably the biggest foe to good circulation. As we all know, the chemical action of caustic on starch will produce a gum. I don't contend there is enough starch to do this, but nevertheless I do contend there is enough starch to produce the first step in this direction, consequently the liquor becomes heavy and syrupy and at the same time sluggish, so that it becomes impossible to get the liquor through the goods as fast as a less viscous solution minus the starch. The stagnation of this heavy liquor causes channeling when getting towards the bottom of the kier and this causes seedy goods.

In preparing the goods for the boil some bleachers steep over night in warm water, other sour the goods before going into the kier, while again some use a malting process; all designed to combat the evil spoken of. It is not my purpose here to discuss the relative merits of these methods. Let it suffice to say there can be no real bottoming of goods unless the starch is thoroughly eliminated. Assuming this has been done, there is no reason why a ten hour boil under twenty or thirty pounds steam pressure with a kier charge of three per cent caustic soda and about two per cent of a good kier assistant should not give a satisfactory boil that will afterwards oxidize with a chlorine titration of one hundred and fifty, or one-half of one degree twaddle, in forty-five minutes to one hour depending on the weight of the goods.

In speaking about boiling I cannot agree with the general practice of boiling all fabrics regardless of construction at the same pressure. A good deal depends also upon what type of kier is used. A kier equipped with the pump and heater system does not require as much steam pressure as the old injector kier where the condensed steam is all the time reducing the strength of the caustic liquor.

I must of necessity touch on circulation. Some bleacheries, I find, are now using a triple flow circulating device which means that the liquor is coming in through a perforated pipe from the bottom up through the grid bar in the center of the kier as well as around the sides. I am very much in favor of any arrangement that will increase the activity of the caustic liquor at a point where frequently inactivity begins. This is usually about four feet from the bottom on down. We all know that in all bleaching and dyeing processes, there are in reality only two methods—one being that of passing goods through liquor and the other being that of passing the liquor through goods. So consequently activity is what we are striving for in circulation.

*Read at Winter meeting, Piedmont Section, Greensboro, N. C., Jan. 27, 1934.

After boiling I would like to say something about the cooling process. It is common practice after the pressure is about gone to open the cold water valve on top of kier and run about four or five thousand gallons of water through the goods. I am opposed to this method for the simple reason that you are making your goods act as a filter, for five thousand gallons of water which sometimes contains impurities that are always deposited on top of the goods. Why not run your water through the mixing kettle under the grid bars and cool from the bottom up? After cooling, the kier will be subsequently drained and when draining you will find that any insolubles, impurities or precipitates will pass freely from the goods at the bottom of the kier. By following this method kier stains will be eliminated and the goods will be decidedly cleaner on the top. Another thing I would like to call your attention to is that this method is less liable to produce tender goods. Tender goods, I believe, are frequently caused by the man in charge of cooling the kiers forcing cold water on the top before the pressure has all gone. This in my opinion is a sure way to tender goods.

There is another point of cooling the kier from the bottom that I would like to touch upon, and this would be interesting especially to the bleacher preparing goods for dyeing and printing. Often in the slasher room they use all kinds of waxes and insoluble substances to smooth the warp so that it will pass through the loom harness without chafing. All of these waxes emulsify and when cooled from the top they settle back into goods, whereas if cooled from the bottom these waxes are forced over the top of the kier through the manhole while in emulsion.

In conclusion let me say that goods treated along these lines will oxidize at the low titration previously mentioned, showing they are thoroughly bottomed and will not give the dyer or printer any trouble. Furthermore these goods will be a permanent white no matter how long they are stored.

It is somewhat difficult, as most of you realize, for one to go into very much detail in a treatise as brief as this, especially when one finds himself in a delicate position as a commercial man when delivering a technical paper. I have purposely refrained from mentioning products, but what I have tried to do is touch briefly on process rather than product. I hope however I have brought out enough material to be the basis for a little discussion. After all that is what we are here for.

CALENDAR OF COMING EVENTS

Outing, Midwest Section

Rochelle, Ill.—June 23.

HAVEG IN THE TEXTILE INDUSTRY

(Continued from page (181) 345)

a number of tanks going to a concern in Switzerland for use, I believe in hydrogen peroxide bleaching.

Mr. Echells: That is in silk bleaching?

Mr. Adams: I am not quite certain about that.

Mr. Echells: Does it have sufficient alkalinity to catalyze peroxide?

Mr. Adams: It is not affected by hydrogen peroxide.

Mr. Echells: How about the color of the Haveg?

Mr. Adams: There is no color there. The brown color is the natural color of the synthetic resin. We call that natural, not brown.

Mr. Echells: That would not affect it?

Mr. Adams: No.

Mr. Bruce: Will the Haveg stand normal bleaching; would it stand, for instance, three grams per liter of sodium hypochlorite?

Mr. Adams: The chances are that it would; but I would rather not make a definite recommendation. That is a question of the mechanics of the operation used in the plant. It should be tested out.

Q.: How about the reaction of phenol to Haveg?

Mr. Adams: It is affected by phenol. Of course, with melted phenols of 90% concentration, there would be an appreciable effect. If the phenol concentration was very low, two or three per cent, I do not think there would be any appreciable effect.

Q.: Is it possible to make an autoclave?

Mr. Adams: Oh, yes. It is not possible to make, at the present stage of our development, jacketted kettles because the heat transmission is low. It is possible to make Haveg vessels which will stand pressure. In that case, we make the Haveg vessel and then surround it with a steel vessel to aid it.

APPLICANTS FOR MEMBERSHIP

Active

William V. Baker—Superintendent, Penna. Dye & Bleach Works, New Cumberland, Pa. Sponsors: C. S. Althouse and Alfred Winkler.

Daniel Baldecchi—Dyer and Vice-President, Pyramid Piece Dye Works, Union City, N. J. Sponsors: P. J. Kennedy and Louis J. Roos.

Eugene Bernat—Chemist, Emile Bernat & Sons Co., Jamaica Plain, Mass. Sponsors: Hyman P. Selya and L. W. Chaft.

Clarence L. Cutler—Supt. of Dyeing, Arlington Mills, Lawrence, Mass. Sponsors: C. L. Nutting and Hugh Christison.

Dwight L. Dimock—Mason, N. H. Sponsors, C. L. Howarth and A. J. Anderson.

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Proceedings of the Ame· can Association of Textile Chemists and Colorists

Notes on Proposed

Mercerizing Committee

of A.A.T.C.C.

By **ALBERT H. GRIMSHAW, M.S., F.A.I.C.**
North Carolina State College

THE speaker had the pleasure of being present at the Chicago Convention of the A.A.T.C.C. last September, and was invited to sit in at the sessions of the main Research Committee. As you all likely know, this Committee is headed by our first President, Dr. Louis Olney.

Many interesting reports were made by the numerous sub-committees which have been doing fine work along many lines of importance to us all in the textile field, especially the finishing and dyeing divisions.

At that time, it was suggested that another committee be formed for the purpose of doing some intensive research work on mercerizing processes. Since that time, an effort has been made to form such a sub-committee. Dr. Olney wrote to quite a number of members asking them to name members who would take an interest and be able to help such a committee. At the Chicago meeting, it was decided that the work of performing the research should be left to the men in the three Sections of the South.

Numerous names were sent to the Chairman of the main Research Committee and he tried to choose from these names, those members who were recommended by the greatest number. This was in the choosing of the men outside of the textile schools. At the Chicago meeting and since that time, it had been suggested that one member of the faculty of each of the textile schools in the South be invited to serve on the committee. It had also been suggested that we try to have two technical mill men from each Section, one of these to be an expert on warp mercerizing and one on piece mercerizing. It was also suggested that the Committee would benefit by the addition of one or two members who would represent the manufacturers of chemicals as used in mercerizing.

At the present time, about ten or more men have signified a willingness to help on this committee. A temporary Chairman has been appointed, and Prof. C. B. Ordway of Alabama Polytech is filling this office in fine style. Prof. Ordway has been sending out data to those who have accepted and has invited them to meet in Atlanta early in February. At this time a permanent set-up of the new committee will be made.

As a member of that committee, the speaker extends to the members of the Piedmont Section an earnest request that they help him to aid the committee by sending to him at North Carolina State College any and all suggestions and criticisms that they see fit to send. We are hoping for much constructive criticism from you all.

Already quite a number of suggested projects have been forwarded to the Chairman. They will be mentioned here for your benefit, with the wish that you will study them and give us your ideas on the matter.

Quite possibly, some of them may not meet with your approval. Please feel free to tell us so and give us the reasons. We will welcome that type of criticism.

1. Thorough study of the common idea—"That mercerized cotton cannot be dyed level," and outlining plans to remove this "old fear" from the dyers' minds through a better understanding of mercerized cotton.

AUTHOR'S NOTE: That comes back to the old argument concerning "tiger stripes," who is to blame? Some very good work on dyeing of mercerized yarn has been described recently by Clibbens and Greake of England.

2. Selection, study, and distribution of valuable data, and pointers concerning mercerized cotton yarns and fabrics.

3. A simple and definite method of measuring luster.

4. Determination of optimum strength of caustic soda, for ideal mercerizing.

5. Determination of conditions of mercerizing that add strength and luster in desired ratio.

6. Determination of optimum temperature of mercerizing liquor and ideal time duration for immersion.

7. Effect of temperature of washing upon the luster

* Presented at Greensboro, N. C., January 27, 1934, meeting of Piedmont Section.

of material. (The study of various chemicals in this capacity may be investigated, such as sodium chloride, etc.)

8. Mercerization without previously boiling-out.

AUTHOR'S NOTE: In connection with the above, the speaker has had a letter recently from one of the best known mercerizers in the South who states as follows: "I think one of the best subjects to start with is the process of mercerizing without boiling-out. I have been doing this in a practical way for over a year."

9. Effect of initial twist in yarn on the final physical character of the mercerized yarn.

10. Really addition to 8. Means of improving results when mercerized materials have not been given a previous boil-out.

11. Simple and positive method of determining the degree of mercerization.

12. Is it necessary to continue the use of preliminary "wetting-out" process before the yarn enters the mercerizing bath? Here is what one man says: "Mercerization may be conducted both prior to and subsequent to boil-off. My experience seems to indicate that when the raw material is in contact with the mercerizing liquor it works essentially as well as after the scouring *only* when the material is thoroughly wet-out and the cotton wax does not protect the cotton fabric. That, of course, involves very thorough penetration." Another note says: "A preliminary wetting-out process before the yarn enters the mercerizing bath seems desirable particularly with raw materials, otherwise the goods are too frequently non-uniformly mercerized." Perhaps we on the committee will receive some good ideas from the manufacturers of various compounds such as sulfonated alcohols, naphthalene sulfonic acid esters, etc., in regard to this proposed project.

13. If the above is necessary (referring to the project of No. 12), is the expense of the addition of a good penetrating agent to the "wetting-out" bath worth its cost in the preparation of the yarn?

14. If the above is not necessary (referring to No. 12), what is the best product to use in the caustic bath to aid in the penetration into the yarn of the caustic liquor, or is it necessary to add a penetrant? Someone has mentioned the good results obtained with cresylic acid, phenol, etc. Others have mentioned that there might be some objections. The committee would like to hear from users of such compounds.

15. Is it of vital importance to control the temperature of the mercerizing bath throughout the run?

16. Should a more careful study of the strength of the acid bath be taken?

17. What is the best preparation to use as a softener or lubricant after the mercerization process? This should form a good project as already we have heard of the good properties of sulfonated alcohols, oils, aliphatic esters, etc. We would like to hear considerable on this subject. What is used and reasons for using?

18. It is necessary to use Aqua Ammonia or some volatile alkaline solution after the acid bath to remove all traces of acid?

19. Which is the best form of drying, rolls or hot air dryers?

The speaker believes that if he learns the answers to all of the above that his knowledge of mercerizing will have increased a thousandfold. Also we hope to increase the knowledge of those of our members who are interested in this project and once more urge all of you to lend us as much aid as possible.

FASTNESS OF DYESTUFFS

(Continued from page (185) 349)

Boston with a high percentage of industrial wastes dispelled in the air and dissolved by rain, deposited on the awning and probably acidic in character react chemically with the mineral colors and destroy them. In Georgia the air is drier, industrial wastes are practically non-existent and consequently the color is more or less unaffected. The results of Pittsburgh exposures are a little difficult to understand unless the surface of the awning was covered quickly with soot which formed a protective coating through which the sunlight, which would be lacking in ultra violet rays anyway, could not penetrate.

In the brief time at my disposal it is impossible to go too much into detail regarding data or theories and all I hope to accomplish is to refresh your memories on some well known facts and to emphasize again the importance of taking nothing for granted. You can be assured that the staffs of the laboratories of the du Pont Company are fully aware of the considerable amount of work that remains to be done to establish color application more than ever on a sound scientific basis. This can only be done by accurate classification of fastness properties by approved standard methods sponsored by the user as well as the manufacturer of color; by study of application methods under all kinds of conditions and on all fibers; by the introduction of new and better colors and textile assistants. Much has been accomplished recently in the latter field. The introduction of compounds of the sulfated fatty alcohol types known as the Gardinols and Avirols represents a progressive step along scientific lines. We must learn to think more progressively to keep pace with new developments and not allow ourselves to fall into the fatal attitude of regarding what we have and what we do as impossible of improvement.

Proceedings of the American Association of Textile Chemists and Colorists

A Theory of Dyeing*

By **HAROLD SCHROEDER**
Chief Chemist and Dyer, Dixie Mercerizing Co., Chattanooga, Tenn.

THE title of this paper is undoubtedly misleading. A theory should be something very weighty and definitely authentic whereas what is to follow is really only a collection of hypothetical surmises. However, in thoroughly capable hands a surmise has, in times past, led to surprising results. You will remember how stout Cortez, silent upon a peak in Darien, with a wild surmise discovered the great Pacific Ocean. Now that really was something to be produced just by a mere surmise and I have often wondered what Cortez, with his obvious gift for surmising, could have done in that line if he had trained himself down and had not wilfully limited himself by staying silent in some out of the way place up in the mountains at that.

Dyeing officially is an art, that is to say, dyeing is a form of skill acquired by experience and maybe we have grown to feel that back of our dyeing there is little or nothing of scientific principles. But whatever is true of dyeing is also true of mathematics. Anybody will concede that mathematics is a science, but a little study of the methods used by the so-called profound mathematicians soon shows that these gentlemen are artists in their line. They make use of trial and error, they even invent their own methods of solving a problem which other mathematicians treat with scorn and they finally arrive at a solution which is only an approximation of the correct answer.

In dyeing we begin with two totally separate phases, our dry cotton fiber and our dyestuff in a keg. It is the dyer's job to evenly disperse the molecules over the cotton fiber so that the resulting absorption spectrum is sufficiently close to that of the standard to pass inspection.

To accomplish this we make use of a common medium which is water and into this water we add what is known as a dyeing assistant, of which there are many available. The dyeing assistant, to be sure, wets out the cotton but it does something far more important, it increases the surface area of the cotton.

By an increase of surface area is not meant an increase in the total volume of the cotton. We can illustrate an increase of surface area by picturing a cube of solid material. Its surface area is the area of its six sides. Now using a very thin knife such as a drug store might use for slicing chicken, we begin slicing the cube into very thin slices. You will see that when the cube is sliced up that its total volume is the same as it was before but instead of only six sides exposed to the air or the dyebath there are now as many times six sides as there are slices. You will also see that if the knife had no thickness, that is to say was infinitely small that we could cut the cube into an infinite number of pieces and the total surface area of the resulting pieces would be as great as that of the universe, which is quite an increase in surface area considering that the total volume of the cube was still unchanged.

Now with cotton the knife that we supposedly use for slicing our cube has a definite thickness and we may consider that it varies for each kind of cotton, so for each kind of cotton there exists a definite possible increase of surface area.

We can express this somewhat mathematically by letting the letter A represent the area exposed to reaction of the dry cotton fiber. Then after the swelling operation the total surface area exposed to the dyestuff of any cotton can be expressed as:

$$NA + C$$

C is a constant depending on the age, previous history and condition of the cotton. N is the number of times that the surface area is increased.

Now let us consider the art of the dyer in the light of this quite simple mathematical formula. We have built the formula up entirely on surmises. Now let us see how it stands the test of what every dyer knows to be good practice.

We all know that mixtures of different cottons are liable to give trouble. This formula shows why, each type of cotton being supposed to have its maximum attainable increase of surface area. The greater the increase of surface area the more dye that is absorbed. We also see how important the wetting out operation is since if it varies in different parts of the same lot we get the effect of mixtures of different cottons.

We also see how important it is to choose the correct dyeing assistant and that we must look for more in our dyeing assistant than simple penetration. For example, assuming a mixture of different types of cotton it is not beyond the bounds of reason to find a dyeing assistant which has a greater swelling action on one type of cotton than on another. Many practical dyers know of such dyeing assistants which they call levelling agents. Dyers

*Presented before the Piedmont Section.

also have learned to choose suitable temperatures for swelling or increasing the surface area of the cotton fiber. When we learned that such and such a dyeing assistant when used at a certain temperature produces a level dyeing we had every right to feel pleased even if we did not know and did not care that we had chosen the correct conditions for producing a uniform increase in surface area in a mixture of different types of cottons.

We can carry this formula a little further, we will again state that

$$NA + C$$

represents the possible increase in surface area of any cotton fiber. Then after mercerizing the formula for this same type of cotton can be written

$$\frac{NA}{X} + C$$

where X is always less than one. In other words mercerizing has conferred upon the cotton a definite increase in surface area.

According to these two formulae then, it should be possible to so manipulate the conditions that the same cotton should produce the same shade before mercerizing as after. This, in the laboratory, is possible, for example the unmercerized cotton may be boiled in caustic soda so that the maximum increase in surface area is attained. The mercerized cotton may be wet out very carefully in water so that a minimum of increase in surface area is obtained. Using these exaggerated conditions and a cold dyebath the unmercerized cotton can be made to absorb more dye than the mercerized. This is an experiment of no particular value to anybody except that it is one application of our mathematical formula.

Once we are allowed to assume that the increase in surface area is the important factor in the absorption of dyestuff and that this increase is a constant for any particular type of cotton we can, as said above, begin to see why it is so important for a dyer to choose the correct swelling agent so that by the use of some special product he can regulate the degree of swelling to suit his conditions and dyeing machinery.

We also begin to understand the important effect of temperature and the surprising differences in dyeing formulae used by different dyers. Again assuming the accuracy of our formula, NA + C, we can see that at some time in the dyeing operation every cotton fiber has to approach the same degree of increase in surface area, and it is a matter of choice on the part of the dyer whether this maximum increase in surface area is attained at the start of the dyeing or by a gradual increase in temperature is built up to during the dyeing operation. The final result, by our formula, must be the same in either case assuming perfect dyeing machinery.

So when we hear that one dyer starts his dyeings at 80°F. and that another dyer starts his dyeings at 140°F. we should not assume it to be evidence of an irrational art but rather that two practical dyers have approached and solved a mathematical problem in two of the many permissible ways and there is no need to attempt to force either of them to use the method of the other.

Now our very simple formula can be carried a little further by introducing a function for the effect of temperature but at this time we will not do that but we shall return to our original system consisting of the cotton fiber, the aggregates of dyestuff and the water.

The same dyeing assistant which has been chosen by the dyer for the results already mentioned is relied on to do one thing more. Besides producing the increase in surface area of the fiber it is necessary for this dyeing agent to disperse or break up the aggregates or clumps of dyestuff molecules below a certain critical size.

You will see that for this theory or surmise it is immaterial whether the dyestuff be a colloid or a crystalloid. You remember that a colloid is like a jelly fish swimming around while a crystalloid is like the salt in the ocean.

The art of the dyer, in the light of our theory, consists in the choice of the correct dye dispersing agent so that the jelly fish of dyestuff is broken up into pieces below a certain size.

You can see that the dyer has been tolerably artful and skillful in that by one addition to his bath he has satisfied two requirements, he has regulated the swelling of his fiber and he has broken up the jelly fish below a certain size and I think we can now realize the tremendous importance to a dyer of the oils or chemicals which he uses in his dyebaths and we can admire the practical skill of the dyeing fraternity in dealing so precisely with such profound scientific phenomena. Dyeing is certainly an art but that art is entitled to rank with that of the physicist and the chemist.

You, no doubt, are wondering why it is that I specify that the dyestuff clumps must be broken up below a certain critical size. By critical size we mean that any lump of dyestuff molecules larger than this size will be uncontrollable in the dyebath while anything below this size will be under the control and responsive to the art of the dyer.

When our cotton fiber is enormously increased in surface area we do not finish with a smooth surface like a piece of glass. We are entitled to assume that the surface of the swollen fiber is like a grating or a piece of window screen. The sizes of the grating varies somewhat with each type of cotton but not so very much.

We now set our dyeing machine in motion and a very interesting and distinctly mathematical process begins to operate. I should have mentioned that the size of our grating must be larger than the critical size of our dyestuff clumps but all a dyer can control is the size of the

dyestuff clumps, he has little to say about the size of the grating.

The dyestuff clumps are swept past the grating and it can be demonstrated mathematically that because of the enormous difference in the relative sizes of the grating and the dyestuff clumps that there is an attraction of the clumps by the grating and therefore at any particular moment a *definite* percentage of the dyestuff clumps will be thrown *through* the grating.

You can see now that the slower the relative speed of the grating and the dye, that the greater percentage of the dye will have time to be attracted by and pass through the grating. You can also see that the faster the speed of the circulation the less is the percentage of the dye which in any given instant can be attracted by and be thrown through the grating until we can conceive of a speed so great that practically none of the dye is thrown through the grating and we do not get the color value out of the dye.

Dyers are accustomed to rely on circulation as a means for promoting levelness of dyeings and this theory or surmise cannot possibly add anything to that knowledge except inasmuch as it affords a plausible explanation for known phenomena. It can and does suggest that the addition of oils or levelling agents can only go just so far in promoting levelling and it also suggests what I think every practical dyer will admit, that we cannot have any dyeing unless there is a performance of external work. That is to say no penetrant, no producer of Brownian motion, can possibly so control the movement of the dyestuff molecules as to throw the necessary percentage through our specified grating. What we have to have and always will have to have is mechanical work performed on our dyeings.

Carrying our theory a little further we can see why dyeing seems to take a definite time, inasmuch as only a definite percentage of the dye present in the bath is at any particular instant being available for dyeing. By this theory only that percentage of the molecules thrown through our grating can do any dyeing, the rest of the dye is dead until its turn comes to be thrown through the grating. Obviously by this theory light shades will be better exhausted than heavy shades and equally obviously heavy shades are never likely to be completely exhausted.

We can also see, following this theory, why perfection of circulation in the dyebath leads to very good dyeings and why it is that good mechanical condition of the dyeing machine is so very important.

We spoke previously of a speed so great that practically none of the dye had a chance to get thrown through the grating. I think all of us who are practical dyers can call to mind such instances. Padding is one, another is continuous indigo dyeing on warps. Dyers who still stick to dyeing in hand boxes may be dyeing shades which require poor circulation and these same shades would result in poor color value if the same formulae without adjustment were used on machines with more complete and rapid circulation.

We have established conditions where at any particular instant a certain definite percentage of the dye is being thrown through our grating and it is time that we finished our dyeing, so we begin to add our salt.

The salt reverses the action of the oil. The oil broke up the jelly fish into pieces smaller than the grating in the cotton. The salt gradually begins to reform the jelly fish until when sufficient is added and the temperature is not too high or is high enough depending on the dyestuff the aggregate of dyestuff is big enough to be attracted by the walls of the grating as it is thrown through. At this point we have our shade. In the case of some dyestuffs which we call not fast the dyeing is finished but in the case of dyestuffs which we call fast to washing the dyestuff aggregate is now absorbed by the walls of the grating and when we speak of tub-fast colors we mean that besides the absorption of the dye by the walls of the grating that the dye has now become insoluble.

This theory or collection of surmises may be carried further and at some future time probably will be. Meanwhile its primary object is not to suggest that dyeing be done by books but simply to demonstrate, if any really was needed, that dyeing, which is an art, is one of the finest of arts and uses for its tools anything and everything that science can find out.

APPLICANTS FOR MEMBERSHIP

(Continued from page (187) 351)

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ENDORSEMENT

General William N. Haskell, executive director of the Code Authority for the Rayon and Silk Dyeing and Printing Industry, expressed his belief recently that President Roosevelt's authorization of exemption of the service industries from certain fair trade practices of the NRA codes, if allowed to apply to the industry that he represents, will remove obstacles to complete enforcement of the code for the industry.

These obstacles, according to General Haskell, have been the price control and cost accounting provisions which have been threatening to undermine the operation of the code. With the probability of removal of these features which General Haskell considers undesirable, the gains made by the industry in controlling its members and the benefits that have accrued to the industry under the NRA and the Code are promised greater permanency by the executive order.

The executive order of the President will probably permit the rayon and silk dyeing and printing industry to make revisions in its code in relation to price control and uniform cost accounting toward which it has recently been working and toward which a definite step was taken recently when General Haskell sent a questionnaire to all members of the industry to determine the consensus of opinion in regard to the code changes for which the Authority proposed to ask.

General Haskell stated that President Roosevelt's action in exempting the service codes provides greater hope of the likelihood of ultimate complete success in the administration of the code of fair competition of the rayon and silk dyeing and printing industry. The General submitted to the Code Authority on Wednesday, May 23, a memorandum in which he outlined certain conclusions that he had reached in his almost four months' experience with the operation of the code. Then and there he termed the price control and cost accounting provisions as "utopian" and admitted that a mistake had been made in writing them into the code. The result has been, he said, to produce a "document impossible of complete enforcement."

In a move to eliminate those provisions from the code the General recommended that the Code Authority submit a questionnaire to the members of the industry to determine whether they favored application to the NRA administrator, General Johnson, to have the provisions removed. The Code Authority acted and sent out the questionnaire to all members, who have it at present in their hands for consideration, and reply.

"On behalf of the Code Authority and for myself, I wish to emphasize our complete confidence in the National Recovery Administration and our own Code," General Haskell stated. "Our own industry appreciates all the benefits that have accrued to it under the NRA and the Code. The question at issue is whether or not our own industry did not write into the Code certain provisions which experience has proven to be undesirable and impractical in enforcement."

"After practical experience with all concerns in the industry in an attempt to enforce those code provisions relating to price stabilizing, I am convinced that it is impractical and undesirable to retain any part of the code which undertakes in any way to control prices or determine a fixed price for any service, even when this price is fixed temporarily and is subject to change," General Haskell stated to the members of the Code Authority.

Such provisions have no place in any code, in the General's opinion. "They create," he declares, "a camouflage and a smoke screen behind which unfair trade practices flourish and are protected by a mantle of hypocritical respectability to the destruction of the ethical." While an honest effort was made to enforce the price control features of the code, he said, it must be recognized that these devices to fix prices have been a noble experiment but they cannot succeed.

Dyeing Aniline Black and Sulfur Black

(Continued from page 338)

bichromate (it is not required to add to this sulfuric acid since the fabric itself introduces sufficient hydrochloric acid). The second and third compartments should contain boiling water, while the remainder can be maintained full of cold flowing water. Under these conditions the entering fabric becomes impregnated with the bichromate solution, but since this is cold very little oxidation takes place. But on entering the boiling water in the next compartment, oxidation immediately commences. At the same time the bichromate begins to dissolve out of the fabric and in this manner excessive oxidation is prevented. It is found that after a few pieces of dyed fabric have passed through the after-chroming plant the conditions of oxidation reach an equilibrium so that afterwards the fabric is uniformly treated.

There is another point connected with the above oxidation process which deserves mention. Many cotton fabrics which are dyed aniline black have white worsted borders or selvedges, and it is necessary that these should remain as white as possible. If the bichromate bath is too acid or hot, the wool in these selvedges acquires a yellowish color (this is probably a result of a mordanting action). But under the conditions of oxidation described above it is very seldom that yellowing of the worsted selvedges takes place.

The dyed fabric after passage over the final range of drying cylinders should have a good deep black appearance but it should also be ungreenable. The following is probably the most satisfactory test for ascertaining whether the dyeing is satisfactory as regards this last named property. Apparatus as shown in Fig. 2 is required, together with a syphon bottle of liquid sulfur dioxide. A portion of the dyed fabric F should be suspended in the upper part of the jar B which contains a small quantity of water. Then the sulfur dioxide gas should be steadily bubbled through the water contained in A so that it becomes moist and thence through B and around the fabric. After five minutes' passage of the gas, the fabric should be withdrawn and compared in shade with a portion not treated. The dyeing may be considered satisfactory if only a small degree of greening has taken place.

(b) Dyeing of Cotton-Viscose Rayon

The application of aniline-black to cotton materials containing viscose rayon follows much the same lines as for cotton. The point worth remembering however is that the rayon definitely tends to dye to a much darker shade than the cotton, so that the resulting dyed fabric often appears unevenly colored. Further, the dyed fabric may be unequally greenable and this may lead to a disastrous change in appearance during prolonged storage in town warehouses. It is therefore essential to prepare the fabric so that the two types of fiber acquire as near an equal depth of color as possible.

The reason for the greater depth of shade which characterizes the viscose in a mixture material dyed with aniline black is that the rayon in the padding process absorbs a much larger amount of the liquor than does the cotton. In direct consequence a larger amount of black pigment forms within the rayon during the subsequent oxidation. Hence it is necessary to prepare the fabric so that the cotton attains its maximum absorptive power if this fiber is to be colored equally to the rayon. As is well known, the usual kiering process has an important influence on the absorptive power of cotton, but it is scarcely economical to subject the mixture fabric to such a preliminary treatment. Generally the most satisfactory course is that of very throughly scouring the fabric with soap and soda ash solutions containing one or other of the various fat emulsifying agents which are now available (for example, Igepon, Gardinol, Amoa, etc.). In this manner a large proportion of the natural and added fats and waxes in the cotton can be removed so that it gains considerably in absorptive power.

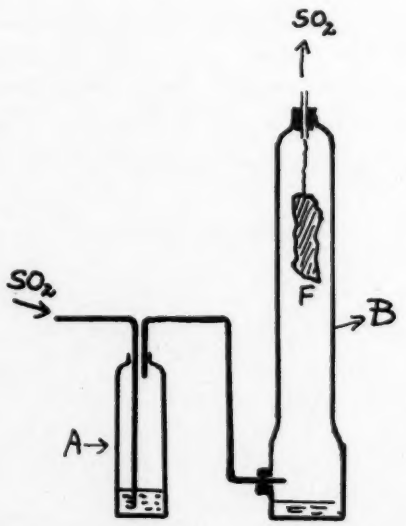

Fig. 2

Mercerization of cotton fabric containing viscose rayon does much to assist the subsequent equal dyeing of the two fibers, but unfortunately this process is not always desired (from the point of view of finish of the fabric) and requires considerable care if the rayon is not to be adversely affected.

(c) Dyeing of Cotton-Acetate Rayon Fabric

This type of fabric is much more difficult to dye aniline black than is the corresponding fabric containing viscose rayon, for acetate rayon has practically no affinity for aniline black as dyed by the usual methods. It will be remembered that an essential part of the aniline black dyeing process consists of impregnating the fabric with a liquor containing the ingredients capable of forming a black pigment. But acetate rayon has little absorbent power for water or an aqueous liquor and therefore it is difficult to produce the black pigment within its fibers. As a matter of fact, it is found in the Prussiate aniline black dyeing of cotton-acetate rayon fabric that the rayon finally appears slightly greenish yellow in color while the cotton gains a full black shade.

In order to produce a solid aniline black shade on cotton-acetate rayon mixture fabric it is therefore necessary to modify the aniline black dyeing process so that it gives a black on the rayon, or to first saponify the acetate rayon to a degree which gives it sufficient absorbent power. The latter method is by far the most economical and there is really very little objection that can be urged against it. On the other hand, if saponification is forbidden then modification of the aniline black dyeing process must be adopted.

The saponification process has been found quite satisfactory when carried out along the following lines. Firstly, batches of about six pieces of fabric are treated in a jigger for about ¾ hour in a nearly boiling bath containing a wetting-out agent, or simply soap, together with sufficient caustic soda which is found by experiment to result in a satisfactory degree of saponification. The fabric is then thoroughly washed free from caustic soda and dried ready for aniline black dyeing. Actually about 15% saponification is all that is necessary since this amount gives the rayon enough absorbency to retain just about the correct amount of aniline black padding liquor.

Alternatively, the saponification process can be made continuous and this is desirable when large quantities of fabric are to be dyed by this method. Under these circumstances the fabric should be led at the rate of about 20 yards per minute through a series of compartments; in the first two compartments there should be a hot dilute solution of caustic soda while in the succeeding compartments there is required a copious flow of hot and cold washing waters. Preferably this plant should be followed by a range of drying cylinders so that the fabric can at the same time be dried ready for aniline black dyeing.

At this stage the fabric can be dyed aniline black by either the Copper or Prussiate methods. One essential feature should be given attention. Excessive saponification gives the acetate rayon such a large absorbent power that it dyes much deeper than the cotton. Hence saponification should be restricted to the minimum amount.

It is found difficult to determine merely by appearance or handle of the saponified and dyed fabric whether or not it has been saponified. This is one reason for claiming the process to be a satisfactory one.

As regards modifying the aniline black process so that it will satisfactorily dye acetate rayon direct (that is, without saponification) it may as well be stated at once that the Prussiate method is quite unsuitable. Possibly this fact arises from the lack of penetration of the catalyst (sodium ferrocyanide) to penetrate the rayon. But on the other hand it is possible to so modify the Copper process that it gives a good black shade on acetate rayon without any pre-treatment. Furthermore, it is possible in producing an aniline black shade on this type of rayon to dispense entirely with the usual aniline black dyeing plant and use ordinary dyeing machinery.

One dyeing process, using the ordinary aniline black dyeing plant, was devised by British Celanese Ltd. (E. P. 311,435). It makes use of the facts that para-aminodiphenylamine is more readily absorbed than aniline by acetate rayon, and that this more complex aromatic amine is more easily oxidized to a deep black pigment much resembling that produced from aniline although substantially less greenable. Also, in order to assist penetration of the padding liquor into the rayon the organic acids, such as acetic and lactic acids, are employed instead of hydrochloric acid. The padding liquor is prepared in the following manner:

Solution A

A 50/50 mixture of aniline and para-aminodiphenylamine	10 parts
50% Lactic acid	10
50% Acetic acid	30
Methylated spirit	20
Water	30

Solution B

Aluminum chloride of 52 Tw	5 parts
Cupric chloride	0.4
Sodium chlorate	6
Gum Arabic	30
Water	54

Before use, these two liquors are mixed in equal proportions; the mixture is then ready for addition to the padding mangles.

The fabric containing acetate rayon is then padded with the liquor described above, almost dried, and afterwards led through a steaming chamber filled with moist air at about 100° C. Under these conditions a good black shade is developed on the fabric.

The method of dyeing aniline black on acetate rayon without the use of an aniline black plant is most conveniently used for fabrics consisting entirely of this type of rayon. Actually the process was devised by the writer some time ago in connection with acetate rayon satin and taffeta fabrics, (E. P. 337,746) and was found to be an improvement on two earlier processes (E. P. 258,699 and 322,893) in which the aniline was replaced by 2:4-diaminodiphenylamine.

For dyeing, the rayon fabric is first well scoured in a

jigger with a hot liquor containing about 0.2% of soap and 0.2% of ammonia. It is then further treated with a fresh liquor at about 75° C. containing about 20% (calculated on the weight of the fabric) of aniline and 2% of para-aminodiphenylamine. Under these conditions the rayon absorbs a considerable proportion of these amines. Then the fabric is rinsed in a cold saturated brine liquor and oxidized in a fresh similar liquor also containing 5% of sodium bichromate, 3% of concentrated hydrochloric acid, 0.5% of copper sulfate, and 0.5% of sodium chlorate. Oxidation is carried out at about 70 to 75° C. and is complete within 15 minutes. Afterwards the fabric should be well soaped to remove loose color and brighten the shade.

In this process the use of a brine solution is a definite feature. When acetate rayon containing absorbed aniline is immersed in dilute hydrochloric acid the amine is rapidly extracted from the rayon. But if much common salt is present this loss of aniline is largely prevented. The brine liquor in the above dyeing process is therefore required to maintain the aniline in the rayon while it is being oxidized by the bichromate, catalytically assisted by the small amount of copper sulfate also present.

The decision as to whether a fabric will be dyed with aniline black or a sulfur black dye is largely determined by circumstances. But if the question of relative fastness of these two dyes is involved then it should be remembered that while both dyes are fast to ordinary washing, aniline black is fast to chlorine and a sulfur dye is not. If it is a case of dyeing according to a given pattern then the following test will be found useful for distinguishing between aniline black and sulfur black.

About a one-inch square of the fabric should be just covered in a white porcelain basin with concentrated sulfuric acid. A few minutes should be allowed for the acid to disintegrate the fabric completely. Then the dark colored product should be rapidly diluted with cold water. A greenish color develops if the fabric is dyed with aniline black, but no distinctive color is formed with a sulfur black dyed fabric. This test can be relied upon, but a confirmatory test consists of boiling a fresh portion of the fabric in dilute acidified sodium hypochlorite solution —a sulfur black dyeing rapidly loses its color and becomes white, while aniline black becomes yellow to brown.

● IODIZED OILS FOR WOOL TEXTILES

By C. H. S. TUPHOLME
4N. Hyde Park Mansions, London, N. W. 1, England

IN THE carding and spinning processes, wool is lubricated with various oils to facilitate its manipulation. In the past such oils have been liable to oxidize and turn rancid, while uneven distribution of the oils sometimes leads to subsequent troubles. In many cases the oil can only be removed in the scouring process by drastic chemical methods. The British Wool Industries Research Association have developed a new type of oil, known as ionized oil, for wool textile purposes, which is specially treated electrically so as to render it non-oxidizable, perfectly water-miscible, and also to possess definite bleaching properties.

The use of this oil has been studied on a commercial scale and during the past year mill tests have been carried out on thousands of yards of cloth, particularly of the grey flannel type. This cloth has been processed with the new oil and is now on the market. A new plant for the production of this oil in bulk has been erected and is now in operation.

● GENERAL RELEASES

Diazo Fast Green GL—a new diazo green which is recommended by the manufacturer for developing with beta naphtol. It is said to produce bluish green shades of good fastness to light, washing and perspiration. It is further claimed that in mixed fabrics it dyes cotton and rayon a uniform shade leaving acetate effects white.

Indanthren Yellow GA Dbl. Paste—a new product identical with the Indanthren Yellow G Dbl. Paste and is best dyed according to the IN method. It is said to possess great tinctorial strength and excellent levelling properties. It is also claimed to be valuable for shading in combinations.

Emulphor EL—a new emulsifier for fatty acids (olein). The advantages and method of working are fully described in Circular I.G. 904.

Supra Light Rubine BLA—a new acid red which is said to be principally of advantage because of its extremely level dyeing properties and very good fastness to light. It is especially recommended by the manufacturers for producing shades on ladies' dress goods, carpet yarns, etc., in combination with Fast Light Yellow 2GX Conc. and Alizarine Direct Blue AGG or ARA.

Celliton Brilliant Yellow FF Powder—an acetate dyestuff which is said to be unique for its extremely clear greenish yellow fluorescent shade. It is recommended by the manufacturer for dyeing and printing. It has poor light fastness but otherwise its properties are said to be satisfactory.

Benzo Fast Grey BM—a direct dyestuff, said to be of particular interest for the hosiery trade because it covers cotton and rayon alike, leaving acetate clear.

Supramine Black BRA—a new acid black said to produce a bloomy, bluish black of good fastness to light, washing, salt water, rubbing and perspiration and is even said to stand a light fulling. Its fastness to carbonizing, steaming, hot pressing and stoving is said to be very good. It is further said to exhaust well from a neutral bath and is useful for shading the wool in union dyeing.

The above mentioned products are all released through the General Dyestuff Corporation from whom copies of circulars describing and illustrating these products may be obtained.

● LOWELL TEXTILE COMMENCEMENT

THE thirty-sixth commencement of Lowell Textile Institute was held at Lowell, Mass., on June 5th. President Charles H. Eames welcomed the gathering and Hon. Edward O. Childs of Newton, Mass., delivered the principal address entitled "The Purpose of Education." The presentation of the class fence ring was made by David J. Fox, president of the class of 1934, to John S. Beattie, president of the class of 1935. An unusual feature of this is that both of these persons are sons of members of the instructing staff of the Lowell Textile Institute. David J. Fox is the son of Russell M. Fox, instructor in textile design, and John S. Beattie is the son of Frederick S. Beattie, assistant professor of organic chemistry.

Awards were made as follows:

Medal of the National Ass'n of Cotton Manufacturers, presented by Charles H. Forsaith, B.T.E., '20:

To David James Fox, Lowell, Mass.

Louis A. Olney Book Prizes (in the form of books): $10 to the student graduating from the Chemistry and Textile Coloring Course, who, in the opinion of the instructing staff of the department, shall have attained a high degree of scholarship combined with oustanding initiative and leadership as a textile chemist:

To Leon Eugene Moody, Lowell, Mass.

$10 and $5 respectively to the students taking the regular Chemistry and Textile Coloring Course who shall be considered as having attained the highest and second highest scholarship in second and first year Chemistry:

Second Year, First Prize: Herbert A. Wormwood, Andover, Mass.; Second Prize: Moushy Markarian, Lowell, Mass.

Honorable Mention: Lee G. Johnston, Haverhill, Mass.; Bernard J. Tyler, Lowell, Mass.

First Year, First Prize: Hugh F. Carroll, Medford, Mass.; Second Prize: Robert K. Lyle, Lowell, Mass.

Honorable Mention: Richard Moushegian, Lowell, Mass.

The following students are eligible for membership in Tau Epsilon Sigma, the scholastic honor society, on the basis of their standing for the first three years, namely, a general average of 80 each term and no failures:

John F. Bogdan, Nashua, N. H.; James C. deGruchy, Jr., Stoneham, Mass.; Evan H. Fairbanks, Wakefield, Mass.; Edward Grossman, Providence, R. I.; Emilio G. Moreno, Jr., Graniteville, Mass.; Joseph Shain, Roxbury, Mass.; Howard N. Stolzberg, Haverhill, Mass.; George R. Thompson, Lowell, Mass.

Following are the names of members of the graduating class and the course of study under which they were enrolled:

Department of Chemistry and Textile Coloring:

Grover Stanley Allen, Edgar Raymond Beigbeder, John Lincoln Birtwell, Mitchell John Bukala*, James Edward Burke, Jr., Charles Lincoln Daley, Francis Clifford Gillespie*, Mitchell Glowienski, Robert Theodore Graham*, Glen Mortimer Kidder*, Raymond Lewis Matthews*, Leon Eugene Moody*, Roland Charles Morrison, Shantilal Hiralal Shah, Harold Smith, Robert Joseph Thomas*, William Joseph Wynn, Jr.

GRADUATES OF THE CHEMISTRY AND DYEING DEPARTMENT
Front row, left to right—Daley, Moody, Wynn, Morrison, Thomas, Allen, Graham, Shah.
Back row, left to right—Matthews, Burke, Birtwell, Beigbeder, Kidder, Glowienski, Gillespie, Smith, Bukala.

Department of Textile Engineering:

Edward Joseph Donohoe, Parker Frank Dunlap*, George Forsythe, David James Fox*, Alden Ives Gifford, Jr., Robert Crockett Gregory*, Russell Munroe Lawson, Gerald Alderic Leblanc, John Charles Lowe*, Simon Shapiro*, Benjamin Thomas, Jr.*, Robert Campbell Wilkie*.

Department of Cotton Manufacture:

William Edwin Stevens.

Department of Wool Manufacture:

Herbert Gardiner Bridges, William Francis Huyck.

*Member of Tau Epsilon Sigma, Scholastic Honor Society.

● FADE-OMETER AND LAUNDER-OMETER

Upon invitation of the Ford Motor Company and Sears, Roebuck & Co., Fade-Ometers will be in actual operation in the beautiful World's Fair buildings erected by those two companies at a Century of Progress in Chicago this summer. The Fade-Ometer is the device that foretells color fastness and thus guides production.

Ford requires Fade-Ometer tests of all upholstery used in the Standard and DeLuxe V-8 1934 model cars—as insurance against fading.

Sears, Roebuck uses the Fade-Ometer to place specific guarantees on the merchandise sold by the organization to the public.

The Launder-Ometer, for predetermining effects of commercial and domestic washing, such as fading, staining, shrinking, mechanical action, will also be in operation in the Sears Building.

The Fade-Ometer and Launder-Ometer are made by Atlas Electric Devices Co., Chicago.

OPEN FORUM

Rules under which this department of the REPORTER is conducted are as follows:

1. Anyone who has a technical problem on which he would like advice may submit it to the Reporter and it will be published in the first available issue.

2. Any reader who feels that he has a solution of the problem may forward his reply to us and if we feel that the reply is suitable it will be published in a succeeding issue.

3. For each such reply published the Reporter will pay a minimum of $2.

4. In case there is more than one answer to the same question, the one covering the subject in the most complete and authentic manner will be published, or if two answers are sufficiently different both will be published. If two answers are considered equally good, the one first received will be given priority.

5. The Reporter will assume no responsibility whatsoever for the accuracy of the answers submitted—it is simply offering a vehicle for the public expression of its readers' opinions.

6. Both the questioner and answerer must send in his complete name and address. When requested we will publish only the initials or other identifying insignia.

Answers

7—I would like a preparation or mordant which, when applied to certain parts of woolen carpet yarn (in skeins), would resist dyeing in an acid dye bath.—**W. K. S.**

Answer—Practically all resists to acid colors on wool are variations of the same basic idea. Method I is suggested for previously dyed wool.

I. Scour and dye skeins as usual. Work for 10 minutes in a cold bath containing 25% sulfuric acid. Wash and immerse in a second bath containing 25% tannic acid. Bring to a boil in one hour and keep at a boil for an additional two hours. Cool down 15 minutes and add 20% Tartar Emetic. Bring to a boil and hold at a boil for 45 minutes. Cool to 100°F. and add 4% tin crystals. Remove skeins after 15 minutes and wash thoroughly.

Method II is somewhat similar to the above but will not felt the wool as much.

II. Immerse the skeins in 40% tannic acid at 180°F. The skeins are worked half an hour and are then left in the cooling liquor overnight. The next day wring the skeins out evenly and immerse in a cold bath containing 20% Tartar Emetic for half an hour. Then rinse lightly and immerse in a fresh cold bath containing 4% tin crystals for 30 minutes. It is usually necessary to add about 1% hydrochloric acid to the tin crystal bath to keep it clear. A final rinse completes the process.

Method III is similar to I but requires less time to accomplish.

III. Enter the skeins into a bath containing 30% tannic acid and 5% acetic acid. Bring slowly to a boil and boil two hours. 15% acetic acid is gradually added while boiling. Then transfer to a second bath containing 4% tin crystals and 6% formic acid. Treat for one hour at 195° F. A final wash completes the resist.

Method IV is the shortest resist process the writer knows of. It is not as completely effective as the others but will answer the purpose in most cases.

IV. Work the skeins 15 minutes at a boil in 10% tannic acid. Wring out evenly and immerse in a cold bath containing 5% Tartar Emetic for 30 minutes. Wring or squeeze out evenly again and immerse cold in a third bath containing 5% tin crystals for 30 minutes. A wash completes the process.

If it is desired to resist only part of the skein, the tub used for resisting is partially filled and the skeins suspended from sticks so that only the portion to be resisted is immersed in the liquor. All percentages given above are based on the weight of woolen material being treated. The treatments can be used both on dyed wool and on undyed skeins.—B. H.

Unanswered Questions

9—I am making tallow softeners on a laboratory scale. To what tests can I subject these tallow softeners in order that I ascertain if they will injure the cotton goods, become rancid, or decompose to form an objectionable compound? I am referring to softeners suitable for cotton piece goods only.—**J. E. G.**

10—We have a particularly difficult problem in holding our bleachery on a set shade of white, due partially to the standard getting soiled from handling as well as from yellowing with age.

We would like some information as to how other bleacheries hold their standard shade of white.—**M. P. C.**

11—In the dyeing and finishing of fabrics which have been treated with rubber latex, or in fabrics made from yarn which contain rubber filament, what precautions should be taken as to temperature in the dyebath and in drying?

Are there any chemicals ordinarily used in dyeing and finishing which should be avoided on account of their deteriorating effect upon the latex or rubber?

In what respects must such a process differ from the ordinary dyeing and finishing of similar material not containing any rubber?—**M. B. P.**

14—Can you give me any information regarding what has been done in the development of ramie for use as a textile fiber? Do you think there is any market for it and for what uses is it particularly adaptable?—**R. M.**

CHEMISTRY OF SILK

(Continued from page 340)

Additional Properties of Fibroin

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THE END

● S.O.C.M.A. MEETING

A luncheon and general meeting of the Synthetic Organic Chemical Manufacturers Association was held at the Chemists' Club, New York City, on Thursday, May 17, 1934, at 12:30 P. M., President Merz presiding. Col. W. S. Weeks, Chairman of the special tariff committee made a report of the tariff situation. Mr. A. L. van Ameringen spoke on the clarification of the definition of the essential oil industry in the code of fair competition for the natural organic products industry and the shorter work week (35 hours) with time and a half for overtime proposed by the NRA for this particular industry. The secretary called attention to the investigations and surveys going forward under Senate Resolutions 325 and 336.

● FASHION SHADES FOR WOOLEN CLOTH

The above is the title of color card No. 876 now being distributed by the Geigy Company, Inc. There are displayed in this card the principal fashion shades which are said to be most likely in demand during the coming season. Complete dyeing instructions are given and in producing the samples, selected Erio colors were used; those which have been sold under the name of Erio Fast and Erio Anthracene and are colors which are said to distinguish themselves by a particularly good fastness to light. Copies of this color card may be obtained on request.

● PROMOTION WORK

E. W. Bell has recently taken over the pioneer and promotion work of Calgon for the Buromin Co. of Pittsburgh, Pa., for the textile industry in New England. Mr. Bell graduated from the Lowell Textile Institute in 1924 and was recently overseer of dyeing for the Malden Spinning and Dyeing Co. of Malden, Mass. Previous to that time he acted as assistant superintendent for the Craigleith Mills, Inc., of Oakland, R. I., and was also overseer of dyeing for the Faulkner & Colony Mfg. Co. of Keene, N. H. At one time he also worked in the dyehouse of the Lowell Dye Works of Lowell, Mass. Mr. Bell has exclusive sales rights of Calgon to the textile, leather and paper manufacturers throughout the greater part of New England and makes his headquarters in Lowell, Mass.

CLASSIFIED

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED: Boss Bleacher, 23 years' experience with thorough practical knowledge of bleaching and processing of Cotton, Rayon and Mixture Piece Goods with Chlorine and peroxide, also mercerizing. Would like to connect with any good Bleachery—First class recommendations. Write Box No. 757, American Dyestuff Reporter, 440 4th Ave., New York, N. Y.

FOREMAN finishing-folding and packing Cotton, Rayons, Celanese piece goods. Mgr. Supt. having any finishing troubles with Rayon Crepes. Can offer with my services a cheap foreign method not patented. 20 years New England Cotton Bleacheries and print works. 10 years New Jersey and New York City Silk and Rayon Plants. Write Box No. 814, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: General superintendent at present employed desires business connection. Have worked from bottom to top. Am practically and technically familiar with finishing plant operation. One position held eleven years. Seven years present location. Very best references. Details gladly furnished. Write Box No. 815, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.